THE SOLENOGASTRES OF THE SIBOGA-EXPEDITION

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BY

H. F. NIERSTRASZ
Utrecht.

With six plates

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I. INTRODUCTION.

Until recently, not a single specimen of Solenogastres from the East-Indian Archipelago was known. It was only in the year 1898 that THIELE gave a short diagnosis of two Australian forms: one from Torres-straits, one from the N. W. coast of Australia (9). In this respect the Siboga-expedition has been more fortunate than its predecessors. The expedition brought back no less than 65 specimens, a description of which follows here.

All these specimens have been fixed in absolute alcohol, and preserved in 95 per cent alcohol, a method, which I believe to be better than any other. And yet it is only of a few specimens that the state of preservation may be called entirely satisfactory. The cause is not difficult to find. Only few forms lead a free life, and can undergo immediate fixation as soon as the contents of dredge or trawl commence to be examined. Others however live in mud; whenever a dredge filled with mud came up, the mud had to be carefully examined and it often took a long time to find the small Solenogastres; during that time they had died and fixation only partly succeeded. The same is the case with the numerous forms we find twisted around the branches of Gorgonids. Owing to the large amount of work which a full dredge necessarily entails, the Solenogastres are only detected when the Gorgonids are inspected. Consequently my sections are often of no value for minute histological details. In the following description I intend to lay stress upon the general structure and to draw the attention to those characteristics, which are of importance for classification.

Before cutting I decalcified the animals in a mixture of 3 per cent nitric acid in 70 per cent alcohol. Though this renders the investigation of certain forms of spicula impossible this method is to be recommended. If not decalcified the sections may be found to be very seriously injured by fragments of larger spicula. After decalcification I stained the animals in toto with

carmalum (after DE GROOT: carminic acid 1 gram, alum 5 grams, iron-oxide amm. sulph. 0.1 gram, distilled water 200 grams) for 2 or 3 days, rinsed them in water, and replaced them in alcohol. Transverse or longitudinal sections were made; several of the animals were very brittle, a circumstance seriously interfering with the cutting, often causing the sections to be broken. This brittleness often made it advisable not to take too thin sections (12.5—15 $\mu\mu$.). The diagrams in perspective have been obtained by careful reconstruction on millimeter-paper of all the tracings of the sections that had been made with the aid of the camera lucida, the situation and size of the organs being therefore quite correct. The spicula were isolated with Eau de Javelle.

II. DESCRIPTION OF THE NEW FORMS.

Proneomenia.

1. *Proneomenia Weberi* nov. spec. (Plate I figs. 1—22).

Stat. 33. Bay of Pidjot, Lombok. 22 M. In mud. 1 Specimen.
Stat. 45. 7° 24′ S., 118° 15′.2 E. Java-Sea. 794 M. Upon Gorgonid. 1 Specimen.
Stat. 177. 2° 24′.5 S., 129° 38′.5 E. Between Ceram and Misool. 1633 M. Upon Gorgonid. 1 Specimen.
Stat. 253. 5° 48′.2 S., 132° 13′ E. Near the Kei-islands. 304 M. Upon Gorgonid. 1 Specimen (fragment).
Stat. 314. 7° 36′ S., 117° 30′.8 E. Java-Sea. 694 M. Upon Gorgonids. 6 Specimens.

Length 18—37 mm. Length-index 22—25. Body proximally bluntly cut off, distally ending in a trunk-shaped elongation. Cloaca with 3 pairs of coeca, extending proximally. Radula strongly developed with 12—18 rows of teeth. The salivary glands remain separated. Cloaca-ducts with vesiculae seminales and receptacula seminis. 2 Strong copulation-spicula.

East-Indian Archipelago. 10 Specimens.

The length of the animal varies from 18—37 mm.; the diameter from 0.75 to 1.5 mm.; the length-index therefore being 22—25. Two specimens are represented, 4 times enlarged, in figs. 1 and 2.

The shape is cylindrical; proximally it is slightly thickened and bluntly truncated. Distally the animal also thickens somewhat and ends in a trunk-shaped prolongation, which may attain the length of 2 mm. To a certain extent we find certain resemblances between this form and Nematomenia flavens and Myzomenia banyulensis (PRUVOT 4, fig. 1 and 2). The colour is dark brown, often greenish. The animal has an exquisitely glittering spicular investment, the spicula intercrossing rectangularly. The ventral groove is distinct. The mouth-opening is visible as a vertical slit.

The spicula are straight or slightly curved hollow tubes, pointed at both ends (fig. 3 A.). This form fully corresponds to that of Proneomenia neapolitana (THIELE 8 fig. 52). The little curved massive spicula (B) are found around the cloaca-opening in great numbers; those of shape *C* occur at the proximal and distal part of the body, whilst along the ventral groove

spicula of shape D are met with: long, curved massive spicula, and amongst these also more flat and broad ones. They occur in a great number of layers superposed upon each other, and make with the body-wall an angle of $\pm 45°$. The cuticula is thick and with its many layers of spicula gives the impression of being the integument of a Proneomenia-species. The state of preservation does not permit of any close observation regarding the mode of formation of the spicula. As to the papillae, of which great numbers are present, these are formed as in Proneomenia neapolitana (Thiele 8 fig. 53), but they are comparatively larger than the latter.

A small dorso-terminal sense-knot is present on the prolongation of the hinder body.

The ventral grove runs from the cloaca-opening as far as a point close behind the mouth-slit. There are three ventral folds: one larger median and two smaller lateral ones; near the cloaca-opening there is only one median fold in the groove, which divides more proximally into three folds (figs. 6 en 7). Here too the ventral groove opens behind the mouth-slit into a cavity ("Flimmerhöhle" of Wirén), which is small and divided into two halves by a dorso-median septum. The "vordere Bauchdrüse" (Wirén) is present in the shape of transparent, thin fibrillar glandular cells, staining pale-red with carmine; they surround the pharynx almost entirely. Amongst these the cells of the "hintere Bauchdrüse" (Wirén) are directly discernible as little round glandular cells, staining obviously. The latter are found, though slightly developed, around the ventral folds all over the animal.

The cloaca is of a rather complicated structure. To elucidate this cf. figures 4—9, representing schematic transverse sections, corresponding to the given lines of the reconstruction fig. 11. The section after line AB (fig. 4) shows that the finger-shaped prolongation of the hinder end is a fold of the dorsal body wall, open ventrally and thus enclosing a distal offset of the cloaca. More proximally (fig. 5) it is seen that the cloaca itself is divided into four divisions. The dorsal division *a*, of which the cavity in the finger-shaped appendage is a continuation, is still visible in fig. 6; in fig. 7 it has made place for the rectum. Part *b* is a paired coecum directed forwards, still visible in fig. 6 but no more visible in fig. 7. The same is the case with *c*, a large sack-shaped coecum, directed forwards and dividing into two coeca. The most considerable extension is obtained by *d*, which extends far forwards (fig. 8); this also forms two coeca. So there are three pairs of coeca, running forwards; in fig. 11 they are not given. The cloaca is clothed with strongly ciliated cylinder-epithelium; in the coeca *d* however the epithelium is not ciliated and of unequal thickness, the wall being therefore undulated. The case is different with the coating of *b*, the epithelium of which forms a great number of papillae with multinucleated stalks; the knob is often dilated vesicularly, as one of the cells swells and becomes transparent. Between the papillae are found openings, in which during the animals life, straight spicula are implanted (fig. 12). In Proneomenia Sluiteri Hubrecht probably describes such another organ as the byssus-gland; HEUSCHER recognised it in the same species; in Proneomenia vagans it also is found. The wall is to be regarded as a part of the integument, which has penetrated into the interior, forming there an organ which may be subservient to copulation.

Of gills or folds of the cloaca-wall, which might perform the function of gills, nothing is present.

Of the nervous system the only thing to be mentioned is, that it fully corresponds to

that of Proneomenia acuminata (Wirén, 6b, pag. 81). Only the sublingual commissure cannot be pointed out with certainty, and the commissures between the ganglia posteriora superiora and inferiora are wanting here.

For the structure of the digestive organs see reconstruction fig. 13. The mouth-cavity is spacious, coated with cubical epithelium and opening into the exterior through an almost perpendicularly placed mouth-slit. In the mouth-cavity we find ciliated "Mundleisten" (Wirén), enclosing numerous cirrhi. In fig. 13 these cirrhi are not indicated; they are found in cavity a. They are broad folds of the mouth-epithelium, sometimes ramified at the basal portion. The cytoplasma of the constituent cells is finely-granular and stains pale-violet with carmine; at the basis of these cells there are bigger or smaller granules, sometimes dilated vesicularly; these are of a bright green colour. The whole of the epithelium of the cirrhi themselves is filled with these green globules, colouring the cirrhi in the sections dark green. This points probably towards a strong secretory function of the cirrhi, though nothing like a secretion can be perceived. Around the mouth-cavity there are numerous strong ganglia, in continuity with the cerebral ganglion through two strong nerves. A tenuous network of nerves connects these ganglia and forms a network all around the mouth-cavity, sending numerous branches towards the cirrhi. This points at the same time towards a strong sensory function.

The pharynx (*p*) — here I follow the division of Simroth (7) — invaginates some way into the mouth-cavity and has a considerably folded wall, encircled by a strong circular muscular layer; these muscles are especially strong in the fold (*b*). No special glands open into the pharynx.

A very strongly made radula is present. As usual the structure cannot be closely investigated, the teeth having been seriously injured in the cutting of the sections. I therefore isolated the radula with Eau de Javelle and put it without damage into glycerin; so I can give the exact structure. It consists of 12 rows of tolerably narrow conical teeth, directing their somewhat curved points backwards (fig. 17*c*). They are all of equal size except those of the two middle rows, which are broader. The teeth stain pale-red with carmalum, but the strong basal-membrane, upon which they are placed, does not stain at all. In fig. 17*a* and *b* and in fig. 13 is represented what is seen of the radula in the sections. In some specimens however the rows of teeth reach the number of 18. This form of radula most resembles that of Proneomenia vagans (Thiele 8, fig. 100, 101). This is the most strongly made radula which has been observed in Solenogastres; fig. 13 gives the relative size. In all the other species, possessing a polystichous radula, this is much smaller and less developed. There can hardly be any question here of its being rudimentary. This is indeed the case with the tongue; the radula is sustained upon a single epithelium-layer. Fig. 17 gives the radula-sac *a*, in which new teeth are being formed. The newly formed teeth are easily discernable as dark-coloured elevations upon the basal membrane, which is to be considered as a cuticular formation. The teeth touch each other at the basal extremities. First the radula takes its course proximally; then it bends, runs ventrally to turn again and to run proximally once more. At the second turning-point the epithelium is thickened and forms pouch *b* built up of long slender epithelium-cells. In this pouch no formation of teeth takes place, which could hardly be expected; cuticula is formed here,

which does not stain, exactly like the basal-membrane of the radula. The purpose of this is not clear. The basal-membrane, after leaving this pouch, does not become thicker, so that increase of cuticular matter does not take place. Reparation of the basal membrane is possible, as on its long course it may have become injured here and there. A strong circular muscular layer surrounds the radula-sac, which is sustained by a few cartilaginous cells (fig. 16*cc*).

On both sides of the radula a salivary gland opens into the pharynx. The salivary glands are long, thick-walled tubes, running ventrally from the intestine.

The part next to the pharynx (the oesophagus, if at least this name may be used) is very small and has a strongly folded wall. This together with the large fold in the ventral pharyngeal wall, situated in front of the radula, renders it possible for the pharynx to be evaginated with the radula. The wall of the oesophagus is built up of cubical epithelium with thick cuticula.

About the intestine there is nothing noteworthy. The lateral coeca are of very regular size. Gradually the intestine merges into the rectum, the epithelium of which is ciliated at the dorsal wall. The transition into the cloaca, the wall of which is entirely ciliated, is gradual.

The generative glands are of normal structure. Both the genital products occur in a mature state in one and the same specimen. They open out into the pericardium through two ciliated ducts.

For the course of the cloaca-ducts see reconstruction fig. 11; it is to be noticed in this figure that only the intestine, generative organs, pericardium and cloaca-ducts are given, and of the cloaca only that part, into which the rectum opens out. The cloaca-ducts first take their course proximally, then bend and run distally to unite into the large precloacal organ (nidamental gland, Schalendrüse of WIRÉN, organe precloacal of PRUVOT). The part of the cloaca-ducts running proximally, which is not glandular, presents a peculiar structure. The portion, passing out of the pericardium, is built up of epithelium-cells of unequal height, the inner surface being therefore undulated, these cells carry cilia (fig. 18 A). Farther on the duct widens considerably and at different points the folds of the wall become so deep as to touch each other; so narrow tubes are formed, running parallel to each other. Several of these tubes are compactly filled with spermatozoa, very regularly placed with their heads directed towards the wall and their tails directed inwardly. In these tubes the cilia have disappeared; only the median part of the cloaca-duct preserves the cilia, amongst which there are a great number of strongly staining granules (fig. 18 B). Close to the point where the cloaca-ducts bend for the second time, they narrow again and are reduced to their former shape. A pretty strong circular muscle surrounds this part of the cloaca-ducts. It appears to me that this extension of surface should perform the function of vesicula seminalis, whilst other appendages may be looked upon as receptacula seminis. These consist of two spacious bags, connected with the cloaca-ducts by short canals. In this there is affinity with Dondersia festiva (Hubrecht 3) and Ismenia ichthyodes (Pruvot 4). The wall consists of cylinder-epithelium with oval nuclei at the basis, strongly ciliated. In these bags numerous spermatozoa, dispersed in every direction, are found; for the rest I do not consider a secretory function impossible. Copulation probably takes place: two strong copulation-spicula are present.

The wall of the precloacal organ is formed as in the other Neomenidae and as that of the end-funnel of the cloaca-ducts of Chaetoderma (Wirén 6[a]). The precloacal organ is small and opens into the cloaca through a small opening (fig. 5).

The above mentioned copulation-spicula are in communication with the cloaca in the part indicated by *c* (fig. 19—21, 7—9 *c s*). Their direction is proximal above the ventral nerve-stems and they extend to some distance anteriorly (cf. Proneomenia vagans, Kow. and Mar. 2). They are either round organs, triangular or somewhat square, apparently calcareous. Such a calcareous spiculum is surrounded by a firm distinctly staining cuticula; around this a layer of epithelium-cells is found. Regarding its formation the following facts should be mentioned. The cellular envelopment increases in bulk considerably at the basis of the spiculum; here the cells become high and cylindrical and are of a peculiarly threadlike structure (fig. 20*b*). In this epithelium-bag is enclosed a cuticular mass (fig. 20*c*) which is continuous in the attenuated cuticular layer around the spiculum. This mass is very finely fibrillar, the fibres being in continuity with those of the cells of the bag. Upon this mass a little column *d* is found, built up of cells and continuous in a very transparent part, in which some nuclei are perceptible. This transparent column is not long; around this we find the basis of the proper spiculum, of which after decalcification nothing is visible. Moreover the spiculum is sustained at the basis by a hard ring *e*, which is structureless and stains obviously. An attenuated circular muscular layer *a* surrounds it entirely. The relation between the said parts and the calcareous spiculum cannot be discovered. To the basis of the spiculum are attached long strong protractors (cf. fig. 19) enveloping the spiculum and attaching themselves to the distal body-wall; (fig. 21 A, *p*) and also strong but shorter retractors, fixed to the ventral and lateral body-wall (*r*). Fig. 21 B shows the shape of a copulation-spiculum, after isolation with Eau de Javelle.

We must not overlook the presence of a pre-anal gland around the cloaca (fig. 6—8), the structure of which may be compared with that of Proneomenia neapolitana (Thiele 8).

Examination of the heart can be properly made when this is in diastole at the death of the animal. The median walls of the pericardial prolongations invaginate (fig. 22 A); these invaginations increase in size and as soon as both offsets have united, the invaginations coalesce and form together the atrium (fig. 22 B, *a*). This atrium, which has consequently a distinct double origin, is open distally and dorsally. Then there is also a ventricle: an invagination of the pericardium, with thicker wall (C, *v*). This interpretation of atrium and ventricle is the more justifiable on account of two points of communication between both, which can be indicated; at those points the wall is much thicker and apparently forms a sphincter (D). The same arrangement obtains in other Solenogastres, which I hope to describe afterwards. In other forms atria are also demonstrated (Hubrecht 2). To me it seems that it should be interpreted in this way: the heart of the Solenogastres is undergoing marked reduction, a reduction running parallel to that of the gills and gill-veins; an opinion also enunciated by Thiele. This opinion is preferable to that of Heuscher (5), who considers the heart of Proneomenia Sluiteri to be in an embryonic condition. It must be owned that the facts hitherto known concerning the structure of the heart cannot be looked upon from one point of view; close investigations, especially in comparison with Chaetoderma, are very desirable.

Of the circulatory system I only mention the dorsal sinus, which takes its course proximally for a considerable distance and is also found distally to the pericardium; besides two lateral sinuses, originating in the distal offset of the animal.

No doubt we have to do with a species of Proneomenia. This species chiefly differs from the type of the genus in its radula, salivary glands, cloaca, cloaca-ducts, copulation-spicula and shape of the body. It cannot be classed among either of the ten known species of Proneomenia.

2. *Proneomenia longa* nov. spec. (Plate 1 figs. 23—40).

Stat. 211. 5°40'.7 S., 120°45'.5 E. Near the isle of Saleyer. 1158 M. 2 Specimens.

Length-index 37—50. Colour varying from yellow-white to light brown. Posterior end elongated trunk-shaped as it is in Proneomenia Weberi. Numerous pointed spicula in many layers upon each other in a thick cuticle. Papillae large and vesicular. Radula polystichous, up to 24 rows; the teeth of the middle-rows are broad, the others are long, either pointed, clubbed or hooked. 2 Long salivary glands, which remain separated. Cloaca-ducts each provided with vesiculae seminales and a vesicular receptaculum seminis. 2 Large copulation-spicula or numerous small ones.

East-Indian Archipelago. 1 Specimens.

Each of the specimens has to be treated separately.

The length of the first specimen is 62 mm., the diameter 1.25 mm. The length-index is therefore 50. The colour is white, somewhat yellowish, glittering owing to spicula, intercrossing rectangularly. The ventral groove is distinctly visible. The hinder part is elongated as is the case with Proneomenia Weberi, though in a slighter degree (cf. fig. 23).

The spicula are of the ordlnary shape, but they are a little larger than those of Proneomenia Weberi; they lie often flat against the body-wall. Along the ventral groove and around the cloaca-opening spicula like those of fig. 3 *B* and *D* are found.

The whole of the tolerably thick cuticle is beset with spicula in many layers upon each other. Numerous papillae pierce the cuticle; they belong to the multi-nucleated type and are met with upon thick stalks. The full-grown papillae are vesicular, round, with some nuclei at the base, surrounded by cytoplasma, which extends along the wall of the vesicle and also travels through the vesicle in fine threads. The stalk shows several nuclei and is of a threadlike structure. The papillae only appear after the formation of the stalks; young papillae are never found in the immediate vicinity of the hypodermis, but always more towards the outside of the cuticle; thus nearly all the papillae are situated at one level. At the end of each stalk a little knob is formed, multinucleated and with strongly granular cytoplasma; in a more advanced stage the knob increases in size and openings occur in the cytoplasma; when full-grown the cytoplasma together with the nuclei removes to the wall, only to traverse the vesicle in a threadlike shape. At last the vesicles break though the cuticle and open (fig. 25).

A dorso-terminal sense-knot is present.

The ventral groove and folds are like those of Proneomenia Weberi. The "Flimmer-

höhle" is spacious and divided into two halves by a median fold, suspended from the dorsal wall. That wall consists of high cylindrical epithelium with round nuclei and very granular cytoplasma; it carries long cilia. The "hintere Bauchdrüse" is only strongly developed around the "Flimmerhöhle", where the glandular cells extend as far as the dorsal part of the pharynx. In a similar stage of development at that place is the "vordere Bauchdrüse" with its crystalline glandular cells.

The mouth-cavity contains numerous cirrhi, here also filled with green granules. The "Mundleisten" present the following divergence: they do not travel along the wall of the mouth-cavity, but they traverse the latter in strings, so that they take their course directly ventrally and cut off a coecum, filled with cirrhi to the right and the left (fig. 24).

When comparing fig. 27 with fig. 13 it becomes evident at once that here the strong folds, separating in Proneomenia Weberi the mouth-cavity from the pharynx, are absent, as well as the folds of the oesophagus. For the rest the salivary glands are similarly placed here; the situation of the radula also coincides. It is different with the structure of the radula. As usual much has been injured in the cutting and consequently a great deal cannot be inferred from the transverse sections. Fig. 26 gives a transverse section. Here it is clearly visible that the radula is polystichous; the number of the teeth is about 24, but there are also several free teeth, the origin of which cannot be traced. The two middle-rows are occupied by broad, flat teeth, presenting some layers, staining in different degree. The other teeth are rather long, straight and slightly clubbed or hooked. Fig. 27 represents the course of the radula: first proximally passing out of the radula-sac then bending ventrally, once more distally surrounded by pouch *b*. This is an epithelial pouch; the radula enters it and folds its borders, in transverse sections the pouch being therefore completely filled with teeth (fig. 28). Both large, flat teeth are thus placed against the dorsal wall; the other walls are beset with the numerous other teeth of which in fig. 28 only a few are given to prevent confusion. The basal-membrane which connects the teeth with each other, is distinct. More distally in the pouch, the radula teeth soon disappear and the epithelial pouch alone remains. In the lumen a grey, extremely finely granular mass is found, which probably has filled the whole of the pouch, but has lost its connection with the wall by fixation. In this mass there are a few round bodies (fig. 28). Here we have the same arrangement as in Proneomenia Weberi; in the pouch most probably a cuticular secretion takes place, perhaps necessary for the strengthening or reparation of the radula-membrane. The radula itself differs from that of Proneomenia Weberi by the shape of the teeth and their number.

For the rest the intestine does not furnish much worthy of note. The wall of the rectum is ciliated and merges gradually into the cloaca-wall; this is characterized by the change of the epithelium. The cubical ciliated epithelium of the rectum is only preserved at the dorsal wall; at the lateral wall the epithelium becomes high and cylindrical with round nuclei, and provided with cilia.

The nervous system is of a structure entirely similar to that of Proneomenia acuminata. (Wirén 6[b] pag. 81).

The animal is mature. Large eggs, full of yolk and with a strong membrane are also found in the pericardium. The genital glands which extend only a very little distance proximally

contain eggs formed at the median wall and spermatozoa formed at the lateral wall. The structure of the efferent canals fully corresponds to that of Proneomenia Weberi (fig. 11). Only the cloaca is of a simpler structure (cf. figs 5—9 with figs 30—35). Fig. 5 corresponds to fig. 30; here also at *b* is an invagination of the body-wall, carrying spicula which here are curved, whereas the papillae are broader and the vesicular knob is much less visible. Only the precloacal organ opens out more proximally, this being therefore not visible is fig. 30. The following figures no longer correspond. Here we observe that the cloaca does not form the proximal coeca *a*, *c* and *d*, but only *a*, into which merges the rectum, its epithelium having been noticed above. The wall of the cloaca is built up of ciliated cylindrical epithelium. More proximally this changes into a multicellular epithelium (fig. 38); the cells are glandular and accumulated, the wall containing therefore in a more or less degree papillae; the whole gives the impression of glandular epithelium with cilia. Along the median part of the dorsal wall runs a strongly ciliated band of epithelial cells. At the lateral cloaca-walls the epithelium is different (fig. 39): regularly granular, ciliated, strongly staining cells alternate with more transparent cells, carrying no cilia. This tissue strongly resembles that of the cloaca-wall of Chaetoderma (Wirén 6[a], Taf. VI fig. 9), though with respect to this absolute certainty cannot be obtained. The possibility of this tissue being also present in this animals cloaca-wall should of course not be excluded, whilst in the other Neomeniidae it is only to be found in the wall of the precloacal organ, this being here also the case. The two copulation-spicula are built as in Proneomenia Weberi.

The structure of the heart may be compared with that of Proneomenia Weberi. On both sides of the median walls of the pericardial offsets, part of the wall is also invaginated, which invaginations fuse into one atrium. In this atrium the original double origin may very easily be recognized (fig. 36). Here too the ventricle is an invagination of the dorsal pericardial wall, of very small extent first, but larger more proximally. The atrium is in continuity with the ventricle, the latter being still very small; here are also two atrio-ventricular openings, both of them closed by a little sphincter. Only one of the openings is visible in fig. 36. The blood-sinus, with the exception of the dorsal one, are very difficult to follow.

The length of the second specimen is 37 mm.; its diameter 1 mm.; the length-index therefore 37. The colour is not yellow-white but light brown. For the rest the appearance is quite the same as that of the first specimen. The structure of the interior also coincides. The radula-sac is very distinct (fig. 37). The radula-teeth are still delicate and curved in the sac; in cutting they are therefore generally touched at two points. The formation takes place simultaneously with that of the basal membrane, which does not differ from the teeth in consistency.

The only real difference between the two specimens lies in the copulation-spicula. Fig. 40 gives a section through the hinder part of the body and may be compared with a section between figs 32 and 33. Here it is seen, that not one copulation-spiculum is found on either side, but that there are several: 5 to the left and 8 to the right. They are small spicula, surrounded by a thin cuticula and sheath, built up of cubical epithelium. Each is provided with its own muscular bundles. They open out into the cloaca at the ventral wall, before the cloaca opens to the exterior.

In my opinion both forms are to be classed in one species, the one point of difference not outbalancing the very important resemblance.

This species is doubtless closely allied to Proneomenia Weberi. The shape of the body, the integument, the cloaca-ducts with appendages, the heart and the copulation-spicula present many points of conformity; buth the length-index, the structure of the radula and the cloaca differ in many respects.

The principal points of difference from the type of the genus are found in the structure of the radula and of the cloaca-ducts, and in the presence of copulation-spicula.

3. *Proneomenia* sp. (Pl. II figs 57—59).

Stat. 87. 0° 32′ S., 119° 39′.8 E., near Palos-bay, W. Celebes. 655 M. In mud. 1 Specimen (fragment).

A fragment of 1 mm. high and broad. The appearance of this posterior extremity is like that of Proneomenia Weberi. The specimen must be mentioned on account of the structure of the cloaca-ducts. Fig. 57 represents a reconstruction of the interior organs. Regarding this the following should be noticed. The cloaca is a simple cavity, without proximal offsets. Gradually its slightly ciliated epithelium changes into the higher strongly ciliated epithelium of the rectum. Laterally the cloaca is continuous with two small coeca (*a*). The course of the cloaca-ducts is normal. The portion, running proximally carries cilia, but is without the vesiculae seminales of the foregoing species. Both parts of the cloaca-ducts, proceeding distally, remain separated (fig. 59). They do not unite into the precloacal organ. The epithelium is rather cubical and not ciliated. Where they curve, the cloaca-ducts are continued into the coeca *b*, uniformly structured; other appendages are absent. Shortly before their opening out into the cloaca, both ducts coalesce, but the unpaired portion is very small (0.05 mm.). Of the well-known tissue of the precloacal organ nothing is perceptible. In other forms this arrangement also obtains in more or less degree. Thiele observed (8) in Proneomenia neapolitana that the cloaca-ducts coalesce, the epithelium of the united part remaining low, not being glandular either. In his opinion there is some relation between this condition and the animal's immaturity. In my specimen the genital glands are small and no production of genital material takes place. Here also the slight development of the cloaca-ducts might go together with the immaturity of the animal. This also Kowalewsky and Marion noticed for Lepidomenia hystrix (2) and Pruvot for Proneomenia vagans (4). However Thiele makes mention for the mature Notomenia clavigera (9) of two glandular cloaca-ducts opening to the exterior separately, but not into the cloaca. For Strophomenia Lacazei Pruvot describes (10) two fully developed cloaca-ducts with appendages, opening out severally into the cloaca. The possibility of the ducts remaining separated in this case too is not excluded, but it is also possible that we have to do with a young specimen. The structure of the cloaca points towards that of Proneomenia longa, though there is not complete similarity between the two. Here too the cloaca-spicula are wanting but perhaps they only develope in maturity. Further, to the right and left, a copulation-spiculum is present, cross-shaped or more triangular, with a delicate cuticular sheath. Very distinct are the dorsal and ventral blood-sinuses,

the latter being enclosed by muscles running horizontally and ventrally; besides two lateral sinuses.

It is much to be regretted that the anterior end of this excellently preserved specimen is wanting. Now it cannot be decided with certainty where to place this form.

Dinomenia nov. gen.

Length-index 11—20. Spicula pointed, hollow, in many layers above each other in a thick cuticle. Papillae numerous. A dorso-terminal sense-organ is present. Three ventral folds. Two unramified tubular salivary glands, which remain separated. Radula distichous. Cloaca-ducts with vesicular appendages. No gills.

4. *Dinomenia Hubrechti* nov. spec. (Pl. II, figs 41—56, Pl. IV, fig. 113).

Stat. 202. 3° 15′ S., 125° 43′.8 E. In horizontal cylinder. 3088 M. 1 Specimen. (See Conclusion).
Stat. 310. 8° 30′ S., 119° 7′.5 E. Between Sumbawa and Flores. 73 M. Upon Gorgonid.

Length 14—16 mm. Length-index 11—13. Body rather pointed at both extremities. The mouth-cavity and the opening of the pharynx separated by a fold. Considerable accumulations of unicellular glands around the pharynx. Five rows of radula-teeth. Two stalked vesicular vesiculae seminales and two stalked vesicular receptacula seminis. Two copulation-spicula.

East-Indian Archipelago. 2 Specimens.

The length of the first specimen is 16 mm.; the diameter 1,25 mm.; the length-index therefore ± 13.

The length of the second specimen is 14 mm.; the diameter also 1.25 mm.; the length-index therefore ± 11.

The colour is brown-yellow, somewhat shining owing to the spicula. The posterior and anterior extremities, both ending rather bluntly, are difficult to distinguish from one another. The ventral groove is distinct (fig. 41).

The spicula are shaped like those of Proneomenia Weberi (fig. 42 A). Besides along the ventral groove long, thin, curved spicula and flat massive ones are found (B). In the tolerably thick cuticle the spicula are lying in many layers upon each other. The state of preservation does not permit of the structure of the integument being studied. The papillae, present in great number, are vesicular with many nuclei, placed upon broad, multinucleated pedicles. Here the mode of growth also corresponds to that of Proneomenia longa: first the pedicle grows out, at the end of which a little knob appears with some cells; this knob increases in size and becomes vesicular. Very seldom, and then mostly in the posterior region of the body, a papilla occurs opening externally. The papillae may grow so large, that they rise as little round protuberances above the surface of the cuticula; even then they do not burst open, but remain closed.

The ventral groove runs as far as the cloaca. The ventral fold represents one large fold, on either side of which another very small one is found. The "Flimmerhöhle" is spacious

and divided into two halves by a median fold of the dorsal wall. In the distal portion of the "Flimmerhöhle" the wall is built up of cylindrical epithelium with long cilia and strongly granular cytoplasma. More proximally this epithelium changes into a cylindrical epithelium, carrying cilia, but staining with difficulty, and remaining very transparent; the nuclei are spindle-shaped and the cells are of a thread-like structure. This region produces a secretion, similarly clear and transparent. This is the "vordere Bauchdrüse" with its secretion, which is found around the organs everywhere in the anterior part of the body. The "hintere Bauchdrüse" is also well developed and its pear-shaped, glandular cells, staining bright red with carmine are found among those of the "vordere Bauchdrüse".

A very small dorso-terminal sense-knot occurs at the very hinder extremity of the animal.

The alimentary canal furnishes some peculiarities, cf. fig. 43, reconstructed out of transverse sections, and the schematic sections figs. 44—47. The cavity *a* may apparently be compared with the mouth-cavity of the other Neomeniidae. Here the numerous cirrhi occur again and also the ciliated "Mundleisten". However the cavity does not lead directly into the pharynx: the proper entrance into it is found in cavity *b*. Both cavities *a* and *b* are separated from each other by a fold (fig. 45*c*). It does not give the impression that this fold occurs here casually; a strong muscle proceeding transversally is found in this fold; moreover a number of muscular fibres, taking their course diagonally, attach themselves to it. I look upon the tolerably perfect separation between the anterior part of the mouth-cavity, which carries organs, and that part, in which the opening of the pharynx is found, as an arrangement, the animal can use at will. Cavity *b* does not carry any organs.

The pharynx itself has a thin folded wall; it runs dorsally and takes up a wide coecum, directed proximally, the wall of which is folded too. An extremely thin circular muscular layer surrounds the wall of the pharynx.

The radula may easily be discerned. It consists of about 5 rows of teeth behind each other. Such a row consists of two large teeth; fig. 49 A represents a whole tooth; B is the upper side of another tooth, C its lower portion. It is evident that regarding the exact structure of the teeth no perfect certainty is obtained. This radula however is distinct distichous, every row consisting of two teeth of shape A, operating as a pair of scissors. So that there is an affinity with Paramenia, Lepidomenia and Ismenia. But in none of these forms does the radula seem to be so strong as it is here, where about 5 pairs of such strong radula-teeth occur.

The typical distichous character of the radula is evident from the radula-sac; in following the radula in distal direction we reach the radula-sac, consisting of two pouches, in each of which a tooth is formed; only more proximally a single radula-sac originates from the coalescence of these two pouches (fig. 50).

The radula teeth are placed upon an epithelial layer with round nuclei, tolerably strong muscles attaching themselves to this. Immediately close to it the salivary glands open out; they are long and take their course ventrally from the intestine (fig. 48). To the right and left of the radula-sac some large cartilaginous cells are found (fig. 47*cc*), serving for support to the above mentioned muscles. Around the two salivary glands and against the wall of the intestine a peculiar glandular tissue is found: unicellular strongly granular glands, grouped in lobes. They

begin directly behind the point where the salivary glands originate, and extend a considerable distance distally. Any opening of these glands cannot be discerned (fig. 113).

Fig. 43 shows that the pharynx distally from the radula narrows considerably and suddenly passes into the intestine, without first forming a separate oesophagus. The intestine itself does not furnish much worthy of note; from my transverse sections the folds are very difficult to trace. The rectum opens out dorsally into the cloaca.

With regard to the nervous system hardly anything can be mentioned, the state of preservation not being such, as to admit of this. Sublingual ganglia cannot be indicated with certainty.

The genital glands only extend a little distance proximally. Genital products are not present. The situation of the organs in the posterior part of the body is represented in the reconstruction fig. 51. The cloaca-ducts take a normal course, unite and form the unpaired precloacal-organ. Where they curve the cloaca-ducts are continued into a coecum, with the same structure as the glandular portion of the precloacal-organ itself. The appendages are remarkable. First a long tube is observed at the end of which there is a pouch, stretching far distally and situated against the body-wall (fig. 51*a*). Into the part of the cloaca-ducts proceeding proximally a small tube opens, leading into a specious pouch with attenuated wall (*b*), built up of cubical epithelium. In neither of these appendages are spermatozoa found (cf. figs. 52—55).

Two copulation-spicula occur in the cloaca (fig. 51*cs*); they are long and run dorsally, their ends being therefore situated dorsally to the rectum. They are not purely calcareous; after decalcification there remains in the sheath a cuticular mass, having in many places round openings, it being therefore quite possible, that not one large spiculum is found here, but several smaller ones, situated next to each other, a phenomenon we also remark in Paramenia Pruvoti. (Pruvot 4 pag. 774).

The heart is of a peculiar structure, though not everything about it is clear to me. In fig. 56 some of the sections are represented. Beginning distally it is seen from *A* that the dorsal pericardial wall is invaginated (*a*), more proximally this invagination becomes bilobed, and next to it another invagination originates (B, *b*). Both *a* and *b* unite and form one large invagination (C, *b* + *a*), this portion of the heart being therefore in some degree trilobate. *D* represents this portion of the heart, which has lost its connection with the pericardium-wall more proximally and is lying free in it. The shape is more or less triangular. More proximally still the heart divides into two halves (E.); both parts regain their connection with the dorsal pericardial wall, and appear as invaginations of it. How to explain those different invaginations? This cannot be done with certainty: *a* and *b* might be atria. But what may be the ventricle in that case? If the invaginations *c* are to be taken for it, then the ventricle is distinctly double, which is possible, but has not been met with as yet. Then atria and ventricles would be situated the one behind the other, a situation also found elsewhere. But this interpretation cannot be sustained with certainty, the structure of *a*, *b* and *c* being exactly alike. Only an accurate comparison with other forms can procure us a good insight into this.

What is indicated in fig. 56 A by *d*, also visible in the following figures is a peculiar accumulation of cells, with large, oval nuclei, staining obviously. Probably these cells carry cilia.

They may be compared with the "bourrelet cilié" which PRUVOT gives for Proneomenia vagans (4 fig. 60). Here however nothing is perceptible of a "gouttière" formed by this band and the heart itself and serving for the passage of the spermatozoa; the "bourrelet" always remains here at a certain distance from the heart, and the pericardial wall between both is by no means deepened. The band proceeds towards the point, where the cloaca-ducts pass out of the pericardium.

The question now arises where to place this form. It cannot be classed in any of the genera known up to now. On account of the distichous radula it departs from Proneomenia, the latter having always a polystichous radula. It might be compared with Paramenia, but from this genus it differs by the structure of the integument and the absence of gills. I look upon this form as a new genus. The structure of the integument and of the radula is of the greatest significance for the Solenogastres. In these characteristics it differs from it closest relations, the genera Proneomenia and Paramenia, with each of which it has one characteristic in common. Therefore it is to be regarded as intermediate between both; it is related to Proneomenia because of the integument and to Paramenia on account of the distichous radula.

5. *Dinomenia verrucosa* nov. spec. (Pl. II, figs. 60—75, Pl. III, figs. 76—82).

Stat. 50. Badjo-Bay, W. coast of Flores. Upon Hydroïd. 40 M. 1 Specimen.
Stat. 164. 1° 42'.5 S., 130° 47'.5 E. Between N. Ceram and New-Guinea. 32 M. 1 Specimen.
Stat. 260. 5° 36'.5 S., 132° 55'.2 E. Near the Kei-Islands. 90 M. 2 Specimens.
Stat. 289. 9° 0'.3 S., 126° 24'.5 E. S. E. coast of Timor. 112 M. In mud. 6 Specimens.
Stat. 310. 8° 30' S., 119° 7'.5 E. To the N. of Sumbawa. Upon Hydroïd. 73 M. 1 Specimen.

The dimensions vary considerably: full grown specimens may obtain the length of 98 mm. The integument is provided with many prominences. The cirrhi in the mouth-cavity are united into bundles. Radula with many rows of teeth. The salivary glands spring from two ventral pouches of the pharynx. A great number of stalked receptacula seminis (or vesiculae seminales). No copulation-spicula.

East-Indian Archipelago. 11 Specimens.

One of the specimens has been represented in fig. 60, drawn from life, in natural size. The length is 98 mm.; average diameter 6.25 mm.; the length-index being therefore 16. Proximally the animal is broad and rather bluntly truncated; more distally it becomes thinner and terminates rather pointedly. The mouth-slit is slanting. The ventral groove is distinct but narrow. Colour: orange-red with bright violet prominences, irregularly dispersed all over the body, only absent on the ventral side. This specimen is full-grown.

Another young specimen is represented in fig. 61 enlarged four times. The length-index of the other specimens varies from 9 to 20, a considerable difference! But the length-index may be said to be 16—20, the one specimen of the length-index 9 showing some deviations, probably not being quite normally developed. Outwardly the different specimens also differ considerably. The animals are either light or dark brown, sometimes with reddish end, sometimes with lighter prominences. Only the largest specimen (fig. 60) is of the above-mentioned two colours, and has to be regarded as the most fully developed; the other specimens, though

often mature, are probably not fully developed. While they were alive, I could at least in none of them detect the two said colours, though all the specimens show the prominences in more or less degree. The interior structure however takes away every doubt regarding affinity.

The cuticle is thick, especially in the foremost and hinder portion; in the middle region of the animal it is comparatively much thinner. It is traversed by many layers of spicula. The prominences are formed by a thickening of the cuticula. The spicula are of the usual shape (fig. 62 A), but are comparatively small and of unequal size. On the prominences they are somewhat larger. The cuticula being thicker there, and the large spicula mostly standing erect, the prominences are immediately conspicuous. The spicula of shape B and C are found along the ventral groove.

There are numerous papillae upon long stalks, not dilating vesicularly. On the prominences they are especially numerous and accumulated, a fact, giving rise to the question whether perhaps any special function has to be attributed to the prominences.

A dorso-terminal sense-organ is present; tolerably strong muscular bundles surround it, by means of which it can probably be stretched and retracted. Around this very small, slightly curved spicula are arranged.

Around the cloaca-opening, where the body-wall forms a shallow furrow, special spicula are also found (fig. 62 D) in considerable numbers, whilst there the papillae are numerous too and of a somewhat different shape.

Behind the "Flimmerhöhle" the ventral fold has five folds, or rather three, the middle and larger one being in some specimens more or less distinctly divided into three: there being in that case five folds. More distally there are only three folds (fig. 81). Just before the cloaca-opening the ventral folds terminate. The "Flimmerhöhle" is not spacious. The folded wall is built up of strongly ciliated cylindrical epithelium; amongst its cells those of the "hintere Bauchdrüse" are seen to open out; these are also found all along the ventral groove. The "hintere Bauchdrüse" is not so strongly developed as it is in other forms: it only encircles the "Flimmerhöhle" but does not extend around the pharynx. The "vordere Bauchdrüse" is not present, at least cannot positively be demonstrated. Here and there among the other glandular cells crystalline cells are found, reminding of the cells of the "vordere Bauchdrüse" of the other Neomeniidae.

The cloaca is of a simple structure. It is a more or less heartshaped space, opening on the ventral side of the animal through a narrow slit. The wall is strongly folded and lined throughout by a strongly ciliated cylindrical epithelium, with oval nuclei. The cloaca divides into two parts: the dorsal and larger portion giving entrance to the rectum, the ventral and smaller one to the precloacal organ (fig. 79 *a* and *b*).

The digestive canal furnishes the greatest peculiarities, see fig. 63. The wide mouth-slit leads into the large mouth-cavity. Very strong "Mundleisten" occur, whilst cirrhi are found in space *a*. These are arranged in bundles. Each bundle is placed upon a small epithelial fold; so that there are a great many bundles isolated from each other. Some of the cirrhi of these bundles have one common base, some stand free from each other. In some specimens the green granules of which we spoke in Proneomenia Weberi are met with. The "Mundleisten" are strongly built and entirely filled with connective tissue. Further there still remains to be mentioned a little

coecum running proximally in the mouth-cavity (b), present in nearly all specimens. Besides there occur folds (c), ventrally suspended from the dorsal wall. This wall is very minutely folded and provided with a strong cuticle; the ventral wall behind the mouth is ciliated.

The transition into the pharynx is gradual. The latter is round, with strongly folded wall and encircled by vigorous circular muscles (m). On the dorsal side the wall is built up of cylindrical epithelium with delicate cuticle. The pharynx unites with the proximal coecum; the part originating from this coalescence is a wide tube, the whole of which is coated by strongly cuticulated epithelium; the wall is minutely folded, which folds grow larger on the ventral side. A little coecum (d), directed distally, is present.

Both widely separated salivary glands take their origin in the ventral wall. They show the following peculiarity: there are two tubes (e) proceeding distally, the wall of which is strongly folded and constituted of rather cubical epithelium. Against the wall an obviously staining mass is situated, which may reach such an extent, as to fill the folds. I look upon this mass as a secretion from the tubes (fig. 64*e*). When looking at figs. 63 and 64 we observe that these tubes pass into narrower ones (s g), formed like the salivary glands of other Neomeniidae; they take their course ventrally from the intestine. These are the salivary glands, which therefore do not open out directly into the pharynx, but through the above-mentioned wide tubes *e*. In none of the Solenogastres known until now has this been observed, nor has it been mentioned of Proneomenia australis (Thiele 9).

Behind the salivary glands the radula is found. The pharynx has already attained here a tolerable width and has the character of the intestine. An oesophagus cannot be distinguished here. The radula is more or less curved and ends in the radula-sac *r*. The radula is well developed and of a distinct distichous character (figs. 65—69). Its structure cannot be thoroughly examined. Any perfect similarity between the different specimens does not exist. Fig. 65 represents the teeth of the largest specimen. *A* is a tooth from the radula itself, *B* a fullgrown tooth from the radula-sac; for the rest there are fragments of teeth, which of course occur in various other shapes. In another specimen the same shape is met with as represented in fig. 65 together with pointed curved fragments (fig. 66). Fig. 67 however shows more comb-shaped teeth.

All these shapes may be reduced to one type, viz. that of fig. 65 A. These teeth are arranged in two rows (fig. 68) upon a very strong basal membrane (b). In the radula-sac the formation of the teeth is seen simultaneously with that of the pedicles *c* by which the teeth are supported. The distichous character of the radula is clearly visible from the radula-sac; it is noticed that the teeth are formed in two separate sets in connection with each other and lined with one continuous epithelial layer, yet remaining separated. Moreover fig. 69 represents the radula at the point, where it bends into the radula-sac: there are two rows of teeth severally separated by an epithelium fold, folded in such a manner with respect to the teeth, as to make the latter exactly fit into it. The radula-sac is alternately directed proximally or distally, there being apparently some relation between its direction and the state of contraction of the intestine.

In one specimen, the one of the length-index 9, a radula cannot possibly be demonstrated, but the structure of the digestive canal corresponds to that of the other specimens.

The intestine takes a normal course; the septa are very regular and alternate with strong

muscular bundles, running dorso-ventrally. The animals feed on Alcyonaria, the remains of which are easily discernible and found in great numbers in the intestine.

When examining fig. 70, a reconstruction of the anterior part of another specimen, a great difference is noticed from fig. 63. Yet there is also a correspondence between the two, considering that in fig. 70 the state of the digestive canal is due to the walls of the mouth-cavity being stretched and the pharynx being contracted, whilst in fig. 63 on the contrary the walls of the mouth-cavity are contracted, the pharynx being stretched. If we suppose in fig. 63 the walls of the mouth-cavity are stretched, then the pharynx takes a different position: it is invaginated into the mouth-cavity; thus the ventral wall of the pharynx is drawn ventrally and the radula and salivary glands change their position. The digestive organs in the anterior region of the body are very movable, which explains the important differences in the transverse sections. The structure of the radula and salivary glands however offers decided points of similarity.

The rectum with its strongly ciliated wall gradually merges into the cloaca. The latter is a vertically placed slit, which widens proximally and gradually takes the shape of a heart; the dorsal part (*a*) passes into the rectum, the ventral and smaller part (*b*) into the precloacal organ (fig. 79).

Fig. 78 shows a reconstruction of the uro-genital organs, out of transverse sections of a young animal. In full-grown specimens the pericardium is so large as often to cover the other organs; it is for this reason that I chose a young animal. Figs. 79—82 give schematic sections through the posterior end of another specimen, comparable with the lines *A B*—*G H* of fig. 78. The one thing worth noticing are the appendages of the cloaca-ducts; they are round pouches, connected with the cloaca-ducts, where these bend, by narrow tubes. In mature specimens they are filled with spermatozoa. The wall consists of cylindrical epithelium, which may become cubical when the vesicles are filled with spermatozoa and therefore dilated. The number varies considerably: very young specimens have none at all, whereas I counted in one mature specimen on both sides about 20. The specimen of fig. 78 is so young that the cloaca-ducts are still separated; yet it has already the receptacula seminis. A similar arrangement also obtains in Proneomenia australis (THIELE 9).

The heart greatly resembles that of Proneomenia Weberi. Here again both atria are already formed before the coalescence of the pericardial offsets; in one specimen they are even already entirely closed (fig. 81). After the atria have united, the double character is still recognisable. The ventricle is again an invagination of the dorsal pericardial wall and in some specimens a double communication is discernible between atrium and ventricle.

Regarding the nervous system the only thing to be mentioned is, that though both lateral nerve-stems are connected by a commissure with the two ventral ones in the distal body-region, yet the commissure between both lateral stems (ganglion posterius superius), above the rectum is wanting.

The question arises, whether we have not to do with Proneomenia australis, of which THIELE gives a short description (9). The length-index of the latter is 18; the cirrhi of the mouth-cavity are arranged in bundles; remains of Alcyonaria are found in the intestine; the receptacula seminis are present: all of them points of resemblance. Points of difference are:

1° The radula of Proneomenia australis is biserial, not distichous, the radula-teeth are rather straight, long and conical; these forms I do not meet in Dinomenia verrucosa.

2° The salivary glands in Proneomenia australis are long tubes, situated ventrally from the intestine. A peculiar condition like that of Dinomenia verrucosa is not mentioned by THIELE.

3° The cuticle of Dinomenia verrucosa shows very conspicuous prominences, also occurring in young specimens.

To me all these seem to be sufficient points of difference to consider these animals a new species. When afterwards the very incomplete account of THIELE has been replaced by more accurate information, it will be seen, whether this view is correct or not.

No doubt this species, as well as the preceding, is related to Proneomenia on account of the structure of the integument, but is also related to Paramenia on account of the distichous radula. Nothing prevents us from arranging this and the preceding form under one genus. The presence of copulation-spicula in only one of both species does not interfere with this arrangement: Proneomenia presents a similar difference.

Proparamenia nov. gen.

Length-index 12—20. Cuticle thick with many layers of pointed spicula and with numerous papillae. Dorsal sense-organ absent. 3 Ventral folds. A circlet of gills in the cloaca. No copulation-spicula. Radula monoserial. 2 Ramified salivary glands, remaining separated. 2 Vesicular receptacula seminis.

6. *Proparamenia bivalens* nov. spec. (Pl. III, figs. 83—100).

Stat. 320. 6° 5′ S., 114° 7′ E. Java-Sea. 82 M. In fine grey mud. 2 Specimens.

Length 18—31 mm. Spicula more or less S-shaped. Number of gills about 20.
2 Specimens in the Java-sea.

Both specimens are in a rather poor state of preservation. One of them is represented in fig. 83, enlarged 4 times. The colour is brownish-yellow, here and there greyish; the anterior part is more or less reddish. The animal is somewhat shining owing to the spicula; the latter are thin needles interlacing in various directions, amongst which the papillae show through as dark points. The ventral groove is distinct and along the whole of its course the spicula are placed in the same direction. Cloaca-spicula are not discernible.

The length of the first specimen is 31 mm., the diameter 1.5 mm.

The length of the second specimens is 18 mm., the diameter 1.5 mm. The length-index varies therefore from 12—20. As neither of the two specimens can be considered mature, the normal length has probably not been reached, the length-index being thus of doubtful value.

The cuticle is strongly developed, especially at both extremities, and entirely beset with spicula, in numerous layers upon each other. The spicula are easily recognisable by their S-shape (fig. 84 A); those of shape *B* are found along the ventral groove. The papillae are numerous and large; they are multi-nucleated and placed upon thick pedicles.

A dorso-terminal sense-knot cannot be indicated.

The ventral groove runs as far as the cloaca and contains 3 folds: 1 large median fold and 2 smaller lateral ones. The "vordere Bauchdrüse" cannot be demonstrated. The "hintere Bauchdrüse" is only slightly developed, except around the "Flimmerhöhle". A very rigorous muscular bundle connects the dorsal wall of the "Flimmerhöhle" with the dorsal body-wall (fig. 85, *m*).

The characteristics of this form are found in the structure of the alimentary canal and gills.

Fig. 87 gives a reconstruction of the anterior part of the alimentary canal. The mouth-cavity is spacious, filled with unramified long cirrhi; the "Mundleisten" are comparatively small. The part next to it, which may be called pharynx, is a long tube, the wall of which is strongly folded, the lumen being therefore extremely small. It is encircled by a strong circular muscular layer, numerous unicellular glands opening out into it.

A well developed radula is present (fig. 88). Passing out of the radula-sac it runs dorsally; then it bends to take a somewhat slanting ventral direction, on account of which it can be touched twice in the transverse sections (fig. 89). Radula-teeth are met with of pointed shape (fig. 88 C), or with two points (A), more comb-shaped (B and E), or consisting of two parts above each other (F). *B* may be a fragment of *F*, and *A*, *C* and *D* fragments of *E*. Shape *E* gives the impression of being an uninjured tooth. There is only 1 row of teeth, the radula being therefore monoserial. A distinct basal membrane carries the teeth (fig. 89). I consider this interpretation the most acceptable; perfect certainty however cannot be obtained. Fig. 90 e. g. represents a section through the radula-sac with 1 tooth, almost of shape *F*. But small pieces (*r. t.*) are moreover found in the radula-sac, lying quite lose from the said tooth. Whether these are fragments or not cannot be decided. Shape *A* reminds of a tooth entirely different from *F* but is probably a fragment; from the transverse sections however can only be concluded that there is but 1 row of teeth. The radula is placed upon a far projecting tongue, coated with cubical epithelium and filled with loose connective tissue; under the radula however the epithelium is multi-layered (fig. 89). The radula-sac is surrounded by a circular muscular layer, from which muscular bundles originate, running towards a number of cartilaginous cells (fig. 90, *c c*), also mutually connected and enveloped by muscles. These cartilaginous cells are very transparent and partly or entirely filled with greenish granules sometimes travelling through the cells as bands.

The salivary glands, which remain separated, spring from the lateral pharyngeal wall, in front of the radula. They are of a peculiar structure and consist of different globular accumulations of glandular cells: narrow cells, strongly granular. Here and there a small lumen is discernible in the globules. They produce a secretion which flows into a canal, by which it is conveyed to the pharynx, the wall of which consists of cubical epithelium; a tolerably strong circular muscular layer surrounds it. These canals — the salivary ducts (fig. 87 *s. d.*) — are ramified several times and end therefore in some blind offsets (fig. 86 *s. d.*). How the matter, secreted by the glandular portion finds its way to the tubes, is not clear, probably between the cells of these. To a certain extent this arrangement also obtains in Rhopalomenia aglaopheniae (Pruvot 4, fig. 46), were lobes of glandular cells surround the salivary glands, here unramified; the opening out of the cells into the ducts is not exactly indicated (cf. fig. 92).

The part next to the radula, is of a similar structure. It finally unites with the proximal dorsal coecum which is of considerable size, to form the intestine. We cannot speak of an oesophagus, the whole region from the mouth-cavity to the intestine having the same structure throughout. This is also evident from the glands, merging into it everywhere; they are strong, pear-shaped glands, opening out between the cells of the pharynx (fig. 91).

In one of the species the intestine is entirely filled with remains of food, showing clearly that it feeds on animal-food (small Vermes?), even on animals of tolerably large size; the alimentary canal is very elastic, which is also confirmed by the strongly folded wall of the pharynx.

As regards the nervous system, I will only mention that the commissures between the ganglion posterius superius and the ganglia posteriora inferiora are absent.

Fig. 93 gives a representation of the structure of the generative organs and of the pericardium, figs. 94—99 representing schematic sections. The structure of the cloaca-ducts corresponds to that of Proneomenia Weberi; the receptacula seminis are stalked vesicles, but the vesiculae seminales are absent. Both specimens are young, the generative organs are not yet fully developed, whence a uniform structure of the cloaca-ducts and the absence of a glandular part. Both cloaca-ducts coalesce and the precloacal organ merges into the cloaca, which enwraps it in two folds (fig. 95). The coalescence of the cloaca-ducts and the presence of the receptacula seminis prove the animals to be half-grown. The cloaca itself is a wide, open space, narrowing proximally.

What is of great importance is, that in the cloaca gills are found, 20 in number (fig. 94). They are strongly folded evaginations of the cloaca-wall, coated with cubical ephithelium and strongly ciliated. They are very full of blood-corpuscles; at the base of each gill-fold a large blood-sinus is present. For this reason it presents great affinity to Paramenia sierra and impexa (Pruvot 4). It is without doubt here that the gills are not evaginations of the rectum-wall as is the opinion expressed by Wirén for Neomenia, (Wirén 6[b]), cf. figs. 94—96; it is seen that the rectum merges into the cloaca far more proximally, the cloaca-wall of the interjacent region being smooth and without gills (fig. 95). Muscular fibres, running in every direction connect the gill-carrying epithelium with the body-wall. Around the gill-folds numerous sharply bordered blood-sinuses are met with; more proximally all these sinuses unite into a few large ones (fig. 95); more proximally still there are only 4 sinuses: 1 on either side of the intestine and 2 dorsally from the pericardium, leading the blood from the gills directly into the heart (fig. 96). The latter is composed of an atrium and a ventricle. Fig. 100 gives 5 sections through the pericardium and through the heart. In *A* the two pericardial offsets are seen, not yet united; the two invaginations going to form the atrium more proximally, are distinct; in each of them one of the above-mentioned gill-sinuses opens (*g. s.*). *B* shows the atrium large and free from the dorsal pericardial wall (*a*). In *C* the ventricle appears, in connection with the atrium through an opening; the wall of the ventricle is thick (D) and only far more proximally (E) it is proved to be an invagination of the dorsal pericardial wall. The dorsal blood-sinus is already visible in *E*.

The place of this form is difficult to fix. The body-investment resembles that of Proneomenia, as well as the radula (cf. Proneomenia neapolitana, Thiele 8, fig. 78). But in Proneomenia

gills never occur. These are only met with in a few forms, viz; in Pruvotia sopita, Macellomenia palifera, Paramenia impexa and sierra, and Neomenia. From Pruvotia it is clearly distinct by the possession of radula and salivary glands. From Paramenia impexa it greatly differs by the presence of 2 salivary glands and of a monoserial radula. Stronger is the resemblance to Paramenia sierra, where the dorsal salivary glands are absent. It considerably differs from Macellomenia palifera with its monoserial radula, the structure of the salivary glands and of the integument being entirely different.

Still in other respects e. g. as regards the shape of the spicula, and the structure of the cloaca-ducts and cloaca there is a difference between this form and PRUVOT's Paramenia. PRUVOT gives the following characteristic for the genus Paramenia: a thick cuticle ("cuticula crassa", 4, pag. 724). Regarding this the following must be noticed: the cuticle is not thick; for Paramenia impexa PRUVOT does not give a description of the cuticle, but as we can learn from his fig. 73, the cuticle is anything but thick, whilst for Paramenia sierra he admits, that the cuticle is rather thin (10, pag. 483). SIMROTH rightly mentions the thin cuticle as being characteristic for the genus Paramenia (7, pag. 232).

The Neomeniidae may be arranged into 2 groups:

1° Forms with thick cuticle, with numerous pointed, hollow spicula in different layers and provided with a great number of hypodermal papillae.

Neomenia Tullberg.
Proneomenia Hubrecht.
Rhopalomenia Simroth.
Pruvotia Thiele.
Strophomenia Pruvot.
Dinomenia nov. gen.
(?) Notomenia Thiele.

2° Forms with thin cuticle, covered with a layer of flat, imbricated spicula, without hypodermal papillae.

Dondersia Hubrecht.
Lepidomenia Kow. & Mar.
Ismenia Pruvot.
Myzomenia Simroth.
Macellomenia Simroth.
Nematomenia Simroth.
Stylomenia Pruvot.
Echinomenia Kow.

Paramenia (Pruvot) may be called intermediate between the two groups: Paramenia impexa approaches more closely group 1, Paramenia sierra group 2.

Proparamenia offers more points of comparison with the first group: the cuticle is thick, the spicula, disposed in many layers, are of the Proneomenia-shape and the papillae are numerous. For this reason as well as on account of the monoserial radula it seems to me

rational to separate Proparamenia and Paramenia, even though there is some affinity both on account of the structure of the salivary glands and the gills. The name Proparamenia has been chosen in order to indicate in some measure the double relation.

Rhopalomenia.

7. *Rhopalomenia indica* nov. spec. (Pl. III, figs. 101—112).

Stat. 5. 7° 46′ S., 114° 30′.5 E. N. E. coast of Java. 330 M. In mud. 4 Specimens.
Stat. 47. Bay of Bima (Sumbawa). 55 M. Upon Gorgonid. 1 Specimen.
Stat. 162. Between Loslos and Broken-islands. W. coast of Salawatti. (W. coast of N. Guinea). 18 M. 1 Specimen.
Stat. 253. 5° 48′.2 S., 132° 13′ E. To the West of the Kei-Islands. 304 M. Upon Gorgonids. 8 Specimens.
Stat. 262. 5° 53′.8 S., 132° 48′.8 L. To the West of the Kei-Islands. 560 M. Upon Gorgonids. 6 Specimens.
Stat. 289. 9° 0′.3 S., 126° 24′.5 E. S. E. coast of Timor. 112 M. In mud. 6 Specimens.
Stat. 305. Between Flores and Lomblen. 113 M. Upon Gorgonids. 2 Specimens.

Length-index 9—26. 2 Long salivary glands, which remain separated. A great number of receptacula seminis. Cloaca in a superficial groove.

East-Indian Archipelago.

This animal is of frequent occurrence and of very variable dimensions. The length varies from 11—39 mm., the diameter from 1—2.5 mm., the length-index from 9—26. This great difference in size must probably be attributed to the animal being either mature or not. The external appearance is the same: terminating rather pointedly. The colour is brown, but sometimes more yellowish or darker (figs. 101—103). The ventral groove is distinct. The integument is glittering owing to the interlacing spicula. In some of the specimens the pharynx has been evaginated out of the mouth-slit.

The spicula are of the ordinary Proneomenia-shape: they are straight or curved and hollow (fig. 104 A). Around the cloaca-opening spicula of shape *C* are found, and along the ventral groove those of shape *B*. The structure of the integument too points directly to the relation with Proneomenia or Dinomenia: the cuticle is thick, with many layers of spicula. Each spiculum is formed by 1 cell, fitting round the base of the young spiculum. The numerous papillae are multicellular.

The dorsal sense-organ is distinct and may be compared with that of Proneomenia Sluiteri (Hubrecht 1, fig. 11); the nerve, from which it is innervated, is also visible.

The ventral groove runs as far as the cloaca and contains 1 large median fold and 2 smaller lateral ones. The "vordere Bauchdrüse" is strongly developed; its clear finely fibrillar cells are met with everywhere in the anterior body-region around the pharynx.

The cloaca-opening is found in a kind of furrow; this furrow, either deep or shallow, is lined with a cuticle, in which numerous flat spicula are implanted; these are placed parallel to each other and are slightly bent (fig. 104 C); in this part papillae are absent (fig. 108 *c. g.*).

The specimens differ chiefly from the preceding species in the structure of the digestive

organs. In fig. 109 a reconstruction of the anterior part is given. The cirrhi and „Mundleisten" are entirely filled with green granules, also met with in Proneomenia Weberi. The pharynx is long and narrow, with folded wall and built up of slender glandular cells. A circular muscular layer surrounds the pharynx; besides it is encircled by numerous accumulations of pear-shaped glandular cells (cf. Rhopalomenia aglaopheniae THIELE 8, pag. 268, fig. 117). The pharynx opens into the spacious intestine, which is provided with a large proximal coecum. It is here that both salivary glands merge into the pharynx separately; they are long and composed of cubical epithelial cells, surrounded by a layer of glandular cells of equal thickness (fig. 112).

Of a radula or radula-sac no trace can be found.

In some specimens the pharynx has been entirely evaginated out of the mouth-slit. In that case the salivary glands and sublingual ganglia are found outside the mouth situated upon the evaginated pharynx.

The intestine with its regular coeca, between which dorso-ventral muscular bundles take their course, and the rectum opening out into the dorsal part of the cloaca, do not present any peculiarities.

The structure of the cloaca-ducts presents the principal points of similarity with Dinomenia verrucosa. Fig. 105 gives a reconstruction of this end. It is obvious that there is much resemblance with fig. 78. In this full-grown specimen the receptacula seminis are very large and entirely filled with spermatozoa. The reconstruction of the receptacula seminis is taken from nature in order to show the shape of the pouches and their situation. Their number varies considerably according to the more or less advanced stage of development of the animals; in fig. 105 it is about 13, a number which may still increase.

Copulation-spicula are absent.

The cloaca is a tolerably small cavity with irregularly folded strongly ciliated wall; gills are entirely absent.

After what has been stated for Proneomenia Weberi the heart does not furnish anything worthy of note.

What has been noted for Dinomenia verrucosa regarding the nervous system holds good here: the commissure between both lateral stems (ganglion posterius superius) is wanting.

This form undoubtedly strongly resembles Proneomenia Weberi. But it should remain distinctly separated from it for the absence of a radula; therefore it has also to be kept distinct from Proneomenia thulensis (THIELE 11) and australis (THIELE 9), which have similarly formed cloaca-ducts.

We must arrange this form under the genus Rhopalomenia, allied to Proneomenia but distinguished from it by the absence of a radula. From Rhopalomenia aglaopheniae Kow. & Mar. it differs in the structure of the salivary glands and the cloaca-ducts.

8. *Rhopalomenia debilis* nov. spec. (Pl. IV, figs. 114—117).

Stat. 204. 4° 20′ S., 122° 58′ E. Northern entrance of Buton-strait. 75—94 M. Upon Gorgonid.
1 Specimen.

Length-index 8. 2 Long salivary glands, which remain separated. Rudimentary radula-sac,

considerably enlarged and dividing into 2 tubes. Separated cloaca-ducts without appendages, the only specimen being very young.

East-Indian Archipelago. 1 Specimen.

A very small animal, measuring 6 mm.; the average diameter is 0.75 mm., the length-index therefore 8. The animal is represented in fig. 114, 4 times enlarged. The colour is brown. The ventral groove is distinct. The animal is shining owing to the fine spicula.

A short description of the specimen is sufficient. It quite coincides with the preceding species. This holds good for all the organs, with the exception of the cloaca-ducts and the pharynx. Here we have to do with a young specimen; the generative organs do not function as yet; the cloaca-ducts are separated and have a thin wall; the receptacula seminis are absent. All these divergences may be a consequence of the immaturity of the animal. Too much importance should not be attached to differences, occurring in these organs.

2 Points of difference should be observed:

1° The furrow in which the cloaca-opening is found, is absent here.

2° Besides the two salivary glands the pharynx has another appendage, a fact of more importance, cf. figs. 115 and 116, sections through the anterior part of the body. In fig. 116 the pharynx has united with the proximal coecum of the intestine; the two salivary glands (*a*) merge into the pharynx more proximally, but are free in fig. 116 and take a normal course. The walls are thick and of a similar structure to those of Rhopalomenia indica (cf. fig. 112). Further a small tube *b* is obvious, opening out into the pharynx more proximally. More distally (fig. 115) *b* divides into 2 tubes, running parallel to the salivary glands but ending much sooner. They are of a curious structure: the wall presents a limited number of rows of square cells, enclosing a lumen, and not perfectly fitting together; here and there something is contained in the lumen (fig. 117), viz; some granular globules, which however gives the impression of being parts of the cells, not a secretion. In many Solenogastres 4 salivary glands occur. The ventral ones are long tubes, 2 in number, as in Proneomenia, merging into the pharynx either separately or united: these are the tubes *a* in figs. 115 and 116. 4 Tubular ventral salivary glands have never been observed: only 2 ventral and 2 dorsal ones (cf. Paramenia impexa).

These tubes *b* might also be compared to the ampullae of Rhopalomenia aglaopheniae (Pruvot 4, fig. 44—46) but the shape of the latter is round and by no means tubular, whereas they open out separately.

A third point of comparison might be presented by the radula-sac, the situation of which corresponds to that of other forms, and which might be rudimentary here. When e. g. a radula disappears the radula-sac no longer functions as such; when increasing in size it may have the appearance, which is shown here and obtain another function. To me this seems to be the best interpretation; it points at the same time to its having originated from a form with distichous radula (cf. the radula-sac of Dinomenia, figs. 48—50, 65—69). This suggestion is the more justifiable on account of the fact, that in Rhopalomenia aglaopheniae a rudimentary radula-sac also occurs (Thiele 8, pag. 267).

Hemimenia nov. gen.

Closely related to Neomenia, from which it differs in the structure of the integument. Length-index 7. Spicula flat, imbricated; no papillae; cuticle thin. Carina with many pouches, filled with large lance-point-shaped spicula. 1 Ventral fold. 1 Pair of vesiculae seminales and 1 pair of receptacula seminis. Communication between the precloacal organ and the penis-spicula. No copulation-organ.

9. *Hemimenia intermedia* nov. spec. (Pl. IV, figs. 118—140. Pl. V, figs. 141—145).

Stat. 49ª. 8° 23'.5 S., 119° 4'.6 E. Sapeh-strait (between Soembawa and Flores). 69 M. 1 Specimen.
Stat. 114. 0° 58'.5 N., 122° 55' E. Entrance of Kwandang-Bay, N. Celebes. 75 M. 1 Specimen.

Length 14 mm. Colour yellowish-brown. Carina distinct, $^1/_{16}$ of the body-height. Number of gills 20. 6—10 Abdominal spicula on each side.

2 Specimens from the East-Indian Archipelago.

The length of the first specimen is 14 mm., the average diameter 2 mm.; the length-index therefore 7.

The second specimen is too much shrivelled to determine the length-index with any accuracy.

The animal is pale yellowish-brown and of a silvery brightness (fig. 118). The ventral groove is distinct; the mouth- and cloaca-opening are visible as little round depressions. The ventral part looks like that of Neomenia grandis (Thiele 8, fig. 1 *a*). A sharply lined carina is present, 0.4 mm. high. Viewed from the dorsal side, it is flat and several round or oval dark spots are distinctly visible (fig. 119).

The small spicula have a flat spatula-shaped appearance, with strong border; the middle portion is thin; they are imbricated (fig. 120 *a*, *f*). Among them there are also found long thin spicula, sometimes bent, often with curved points, but few in number (*c*, *d*, *e*). All along the ventral groove however, they are arranged profusely. On the carina a third form is detected, viz. large, firm lance-pointed spicula (*b*). These are found at the above mentioned spots on the carina. Such a round spot proves to be a little cavity, entirely filled with these spicula. In Neomenia these spicula are also found in small numbers (cf. Wirén taf. II, figs. 3—6), and especially in Neomenia grandis (cf. Thiele 8, fig. 2 *a*); in this species they are only situated on the carina.

I could not demonstrate any special spicula round the mouth- or the cloaca-opening, as I decalcified the specimens before making the sections.

The cuticle is thin, as compared with the hypodermis (fig. 121); its thickness never exceeds half of that of the hypodermis; as it is traversed throughout by the very numerous spicula, only a very thin layer remains. The hypodermis on the contrary is thick and appears to me to consist of two layers of cells; two rows of nuclei are seen one above the other; sometimes the contour of the cells, clasping each other wedgewise, is visible too, but my sections do not give any positive certainty regarding this point (fig. 121).

Papillae are entirely absent, which was to be expected, the cuticle being too thin. In this Hemimenia differs greatly from Neomenia. The layer of hypodermal cells is of unequal height indeed; sometimes thread-like offsets from the hypodermal cells penetrate into the cuticle, but formation of papillae does not take place everywhere.

In the small pouches upon the carina the structure differs. There the thickness of the hypodermis is only one cellular layer, whereas the cuticle is thicker than the hypodermis (fig. 122). Sometimes the pouches are more or less divided into two by a longitudinal median fold of the hypodermis (figs. 140—141). Here also papillae are absent, but the hypodermal cells have offsets, which pierce the cuticle; these offsets are either broad or very thin and often provided at the end with a little transparent knob (fig. 122). This might be considered as a papilla, but for its great difference from the proper papillae of Neomenia. In the thick cuticle of the pouches the lance-point-shaped spicula are implanted, amongst these thin cuticular columns are situated, usually ending in a little knob. The function of the pouches is not clear, though they have probably to be regarded as a sense-organ.

The ventral groove is distinct, but very narrow and proceeds to a place close before the cloaca. On either side of the ventral groove a kind of lip is found (cf. THIELE 8, pag. 224). There is some difference between Hemimenia and Neomenia in there being only 1 ventral fold and not 7 or 9. This ventral fold is large and broad. The epithelium of the ventral groove and ventral fold carries cilia in the posterior portion. The "vordere Bauchdrüse" with its transparent very finely fibrillar cells and the "hintere Bauchdrüse" are both well developed.

We should not overlook the organ, described by THIELE as "abdominal spicula", by WIRÉN as "finger-shaped glands". Fig. 135 shows some openings, round or oval-shaped (*a. s.*) to the right and left of the ventral fold. They are short hollow tubes, lined with cubical epithelium and opening to the exterior more distally. It is a moot point whether they are spicula or a gland; the tubes are entirely or partly filled with some cuticular matter. They give the impression of being spicula and not glands. Their number is for the first specimen 6 on each side, for the second on one side 8, and on the other side 10. These numbers are much smaller than those found in Neomenia.

A dorso-terminal sense organ, as indicated for Neomenia grandis, is absent.

The diaphragma is absent, which was also the case in Neomenia grandis.

The nervous system fully corresponds to that of Neomenia carinata (WIRÉN 6b pag. 66, fig. 6 B). The commissures between the ganglion posterius superius and the ganglia posteriora inferiora take a peculiar course; they wind their way between the penis-spicula and cloaca-ducts, ventrally to the intestine (figs. 138—140).

The following is noticed with regard to the structure of the alimentary canal. A longitudinal section through the anterior region of the first specimen is represented in fig. 123, with which correspond the transverse sections of figs. 124—130. The mouth-cavity is not spacious; the lateral and dorsal walls are beset with cirrhi; more or less arranged into bundles and ramified at the base. The "Mundleisten" are in the shape of a horse-shoe. In fig. 124 at *b* is a coecum of the pharynx, directed proximally; at *a* is a transverse fold of the epithelium. Fig. 125 shows that the coecum *b* is one continued whole with the mouth-cavity, and represents the two folds of *a*.

After the mouth-cavity comes the pharynx, a long rather straight tube. The ventral wall has a fold *c* (fig. 126). The pharynx is entirely surrounded by strong circular muscles, amongst which however muscular fibres diverge in different directions; *p* and *f* are similarly encircled by muscles. In transverse sections the pharynx is cross-shaped (fig. 127). Distally the pharynx narrows and is continuous with the proximal coecum *d*; at the ventral wall the fold *f* is found, full of connective tissue and muscular fibres. Fold *f* carries two other smaller folds *g*, which in fig. 130 are no longer in connection with *f*, whilst *f* is loose from the pharyngeal wall.

In order to establish the resemblance to Neomenia, compare fig. 123 with WIRÉN's fig. 1, taf. IV, (6^b). There are some points of resemblance e. g. the mouth-cavity with the cirrhi, and the proximal coecum (*d* = Sh). The proboscis of Neomenia carinata may be present here in folds *f* and *p*, but both „Schlundleisten" (S L) are looked for in vain. Neomenia microsolen offers points of affinity; Neomenia Dalyelli, in which the „Schlundleisten" and proboscis are absent, offers even more. THIELE's description of Neomenia grandis is not quite clear; there is probably more resemblance between Neomenia grandis and carinata than between Neomenia grandis and Hemimenia. We cannot however be too cautious in making comparisons, the state of contraction of the pharynx being of much importance. This is confirmed by the second specimen, the pharynx of which is quite straight, wide at first but very narrow further on; the folds *b* and *c* are absent; *f* is present but very small. In this specimen numerous glandular cells are met with around the pharynx and among the pharyngeal muscles; pear-shaped cells arranged in groups and opening into the pharynx. In the first specimen nothing of all this is perceptible. For Neomenia grandis THIELE has figured similar glands but much less developed.

The intestine is large and broad and provided with regular coeca. In the anterior part it is exclusively constituted of ciliated epithelium; more distally cilia are only to be indicated at the dorsal wall. The intestine is entirely surrounded by a thin muscular layer. The animal feeds on sponge; in one of the specimens the alimentary canal is filled with rests of food, amongst which there are numerous sponge-spicula. The short strongly ciliated rectum has a folded wall.

Figs. 131—139 show the structure of the cloaca. In fig. 131 the cloaca is open ventrally; in fig. 132 the ventral walls are slightly closed, which is more obvious still in fig. 133. In fig. 134 the cloaca is closed ventrally and divides into two, the closing lips having united dorsally from the penis-spicula. In that way 2 cavities are formed: the large dorsal one *a* and the smaller ventral one *b*. The cavity *a* is clothed by cubical ciliated epithelium and leads into the rectum (fig. 134). Fig. 134 represents the 2 cavities *c* uniting more proximally into one large cavity (fig. 135). The latter is an opening in the connective tissue surrounding the organs, without any proper wall, rendering it possible for the precloacal organ to be movable. Blood-corpuscles are not contained in it. In fig. 137 it is seen that the precloacal organ opens out into cavity *b*, and therefore into the cloaca. From a comparison with Neomenia carinata it is evident that the "Vorhof" of WIRÉN is here a very narrow tube, provided with strong muscles, and built up of strongly ciliated epithelium (*b*). This difference is of special importance, a copulation-organ being absent here. Hence there is some resemblance to Neomenia Dalyelli. The ventral part of the cloaca *b* does not carry gill-lamellae.

In the dorsal cloacal portion the gill-lamellae are found. Their number is about 20, a

considerably smaller number than observed in Neomenia. They are of various sizes; from smaller single folds to larger ramified ones. They are filled with blood-corpuscles, which are either round or oval-shaped and very large with oval nuclei and yellowish cytoplasma. Around the gills there is a compact, dense tissue, which WIRÉN designates in Neomenia carinata with the name of blood-gland. Lacunae are observed in it, permitting the blood to flow from the adjacent tissue into the gill-lamellae. Around the blood-gland no special blood-sinuses are to be demonstrated; the blood circulates through the loose connective tissue. In fig. 131—133 the red lines *f* represent the course of the blood and not the presence of a special circular blood-sinus. The blood, flowing from the gills through the blood-gland and the connective tissue accumulates in some sinuses, dorsally to the cloaca (fig. 132—135), by which it is directly led into the atrium. This atrium has originated from the union of 2 invaginations of the distal pericardial offsets, and has therefore a double origin; the ventricle is an invagination of the dorsal pericardial wall (fig. 137). Probably there are also 2 atrio-ventricular openings. Of the blood-sinuses the dorsal and ventral one are to be mentioned, the large nerve-knots and the rectum being also surrounded by blood-lacunae (figs. 123, 136, 137). In Neomenia carinata and Dalyelli the atrium — (it is better to say atrium than gill-vein) — is single (WIRÉN, 6[b], pag. 56), though WIRÉN believes it to be the coalescence of 2 parts as also appears from his figure 5, plate VIII and from fig. 7, plate IX. In Neomenia grandis the atrium is single.

The genital glands do not present anything noteworthy. The animals are fully mature; eggs and spermatozoa occur in great numbers. The part of the cloaca-ducts passing out of the pericardium, is a straight tube with folded wall, built up of ciliated epithelium, surrounded by a strong circular muscle (fig. 138). This part is connected with a spacious bag, with non-ciliated wall and similarly encircled by a muscular layer (fig. 140 *v s + d'*). These pouches (fig. 139 *v. s.*) are entirely filled with spermatozoa, the heads of all of them being directed towards the wall. They probably are vesiculae seminales and may be compared to the ampullae of Neomenia grandis (THIELE 8, pag. 240), the latter however being of the nature of widenings of the cloaca-ducts in Neomenia carinata (WIRÉN 6[b], plate VII, fig. 2 B). The cloaca-ducts first proceed proximally in the shape of wide tubes filled with spermatozoa, to bend afterwards and to run distally. At the point of bending a thin winding tube is found, 1 to the right and 1 to the left, leading into a large receptaculum seminis, a spacious bag of cubical epithelium and filled with spermatozoa (fig. 143).

The precloacal organ is large (fig. 138). A copulation-organ is entirely absent as is the case in Neomenia Dalyelli. The precloacal organ is of the usual structure, only the end, opening into the cloaca, has a wall composed of cubical ciliated epithelium. The genital products passing from the precloacal organ into the cloaca (*b*) are not directly ejected but are also met with in part *a* of the cloaca (fig. 133 *o v*).

The portion of the cloaca-ducts taking its course distally, is provided with an appendage, not present in Neomenia. To make this clear I must first mention the penis-spicula ("strangförmige Organe" WIRÉN; "cordlike organs" TULLBERG; "penis-spicula" THIELE). Their course is shown in figs. 133—140. Here too, they consist of a "rinnenförmige" and "pfriemförmige" bar, running parallel to each other. The penis-spicula protrude into the cloaca, where both bars

unite into one (fig. 145 A). In fig. 145 both the situation and the shape of the two bars is represented. Probably the bars consist on the outside of cuticular matter, remaining after decalcification, and staining faintly with carmine; the inner part appears to me to have been calcareous. The bars may also be hollow (cf. THIELE 8 fig. 47). Each bar is encircled by a cubical epithelial layer, which is likewise surrounded by muscles: protractors and retractors. Of a common epithelial layer surrounding them nothing is perceptible. The glands belonging to the penis-spicula are well developed. In fig. 135 *h* they are seen (violet) on the point of opening into the covering of the penis-spicula; their course is represented in figs. 136—140. Fig. 139 shows a small vesicle *g*, connected with the precloacal organ by means of a little tube (fig. 138); *g* and *h* unite into one large vesicle *g* + *h* (fig. 140), increasing in size more proximally and dividing into lobes, as in fig. 142 it has been touched more than once. This is undoubtedly the gland of the penis-spicula, described by WIRÉN and THIELE. Fig. 144 B represents the structure of its wall: long strongly granular glandular cells, ciliated and with oval nuclei (*a*); at different points the granules increase considerably in number and stain intensely with carmine, the whole of the cells becoming dark-red (*b*). These granular cells are especially found in vesicle *g*. After *g* and *h* have united this difference becomes evident, but more proximally cells, more granular, are intermixed with cells less granular. Here and there the cells open and the granules are discharged into the lumen of the gland. What kind of organ may this be? WIRÉN and THIELE look upon the penis-spicula as being in some way connected with the copulation, a view which to me too seems correct; the function of *g* however cannot be made out. The spermatozoa from the precloacal organ might pass through *g* and *h* and then go to the penis-spicula; the name of the latter would be the more justifiable on this account. Besides its secretory function the gland might also perform the office of vesicula seminalis, the size and width of the gland favouring this view; the secretion might procure enveloping matter for the spermatozoa. This may to a certain extent also explain the fact of the spicula being hollow. Evidence against this view is the presence of numerous spermatozoa in the precloacal organ, whereas in *g* they are entirely absent. Another interpretation is this; in the gland a secretion is formed, partly conveyed to the penis-spicula, partly to the precloacal organ, which is confirmed by the presence of obviously staining granules in the precloacal organ and in tube *g*.

Hemimenia is, no doubt, closely related to Neomenia. Yet I feel justified in considering it another genus on account of the structure of the integument, which differs very considerably from that of Neomenia. Neomenia belongs to the forms with thick cuticle, pointed spicula and papillae, (group 1 pag. 21), Hemimenia to those with thin cuticle, flat imbricated spicula, without papillae (group 2). It is therefore a transition-form and as such may be compared with Paramenia.

Cyclomenia nov. gen.

Length-index 7. Shape of the body cylindrical, proximally bluntly truncated, distally narrower and more pointed. Dorsal sense-organ present. Cuticle thick. Spicula pointed and in

many layers. Papillae almost entirely absent. 3 Ventral folds. Radula distichous, very large; broad bands with small teeth, close against the pharyngeal wall. Radula-sac very spacious and invaginated. 2 Globular salivary glands, without lumen or efferent canals. Cloaca-ducts without appendages, but winding and considerably widened. 3 Small copulation-spicula. A circlet of gills in the cloaca.

10. *Cyclomenia holosericea* nov. spec. (Plate V figs. 146—171).

Stat. 300. 10° 48'.6 S., 123° 23'.1 E. E. coast of Rotti, to the west of Timor. In fine grey mud. 918 M. 1 Specimen.

Length 13 mm. Bronze-coloured with dark ring at the anterior part. Number of gills about 20.

1 Specimen from the East-Indian Archipelago.

It is represented in fig. 146, 4 times enlarged. The length is 13 mm. At the anterior end the diameter is 2 mm., at the posterior end 1,5 mm.; average diameter 1.75 mm. The length-index is therefore about 7. The shape of the animal is cylindrical; the sections are perfectly round; hence the name. The anterior extremity is broad and blunt at the end. The ventral groove is distinct, the mouth-opening slit-like. The colour is dark grey, somewhat greenish or bronze. At the anterior end a dark ring is noticed. The animal is not shining, but velvety; spicula are not visible.

The spicula (fig. 147) are of the Proneomenia-shape: hollow, straight or S-shaped (A); along the ventral groove they are broad, though thin and very transparent (B).

The cuticle is rather thick and transversed by spicula in various directions (fig. 148). The hypodermis is only 1 cell thick and consists of narrow epithelial cells, with finely granular or fibrillar cytoplasma; often the cells are broader in which case they are transparent. A spiculum originates from 1 cell, which afterwards surrounds it as a little cap. The spicula remain in connection with the hypodermis by thin threads, met with everywhere in the spicula. Papillae are absent. In fig. 164 on either side (*p*) a little knob appears, formed by a protraction of the hypodermis and the muscles of the body-wall. By these knobs a superficial ventral furrow is bordered. Here the cuticle is slightly thinner, whereas the hypodermis forms transparent or extremely minute knobs, upon thin stalks (fig. 150).

The cuticle is covered throughout with a thick layer of dirt, which hides the spicula from view and causes the velvety appearance.

A dorso-terminal sense-knot is present on the terminal extremity of the animal.

The ventral groove runs from behind the mouth as far as a little way before the cloaca-opening and has one large median fold and two smaller lateral ones. The "Flimmerhöhle" is spacious and divided by a dorsal wall into a left and a right half (fig. 152): the wall carries very long cilia. The "hintere Bauchdrüse" is very strongly developed, especially around the "Flimmerhöhle"; its granular, deeply staining glandular cells extend on either side of the pharynx; more distally the gland becomes less developed, though still discernible. Amongst its cells all

around the pharynx numerous round or pear-shaped glandular cells are found, with round nuclei and finely granular cytoplasma. These are probably the cells of the "vordere Bauchdrüse", but this cannot be determined with certainty.

The structure of the alimentary canal in the anterior part of the body furnishes the greatest peculiarities. Fig. 150 gives a reconstruction; the schematic sections figs. 151—157 correspond to the lines *AB*—*NO*. The mouth-cavity is large, but partly filled with the fold *f* of the dorsal wall. A great number of ramified cirrhi are present; "Mundleisten" are absent. Distally from the fold *f*, the mouth-epithelium is strongly folded and ciliated. The mouth-cavity leads into the pharynx, similarly provided with a folded ciliated wall in the anterior region; more distally the shape of the pharynx becomes more round or irregularly oval-shaped (fig. 152). More distally it widens considerably.

2 Salivary glands merge into the pharynx; they are globular organs (fig. 153 *sg.*), consisting of long granular glandular cells with round nuclei. A lumen is wanting, but between the glandular cells small openings and slits occur, enabling the secretion to flow into the pharynx. In fig. 154 it is seen that the pharynx is going to divide into a large ventral part and a smaller dorsal one; the latter is separated from the first and leads into the intestine after having united itself with the proximal coecum (fig. 155). This coecum is large, with strongly folded wall, more proximally divided into different parts (fig. 153). The pharynx is for some length continued into the intestine as a deep fold, the folds *p* closing ventrally from the pharynx (figs. 155 and 156).

Very remarkable are the radula and the radula-sac. Figs. 154—156 show the folded wall of *a* in the lumen of the pharynx *b*. More distally in fig. 156 it is seen that the dorsal walls of *a* and *b* unite; in fig. 157 it becomes clear that *a* is an invagination of *b*. Thus the distal and dorsal wall of the ventral portion *b* of the pharynx is invaginated. The wall of *b* is built up of cubical epithelium (fig. 158). The structure of *a* is different: fig. 158 shows that the wall is peculiarly folded; the dorsal folded wall partly consists of cubical, partly of cylindrical epithelium with oval nuclei and strongly fibrillar cytoplasma. It is by these walls that the radula is formed. The latter is an exclusively cuticular formation: a basal membrane with some teeth, attached to the radula-sac in crypts. The teeth are more intensely stained with carmine than the basal membrane itself, but undoubtedly the basal membrane and teeth form together one mass. More proximally the walls of *a* and *b* approach and are lying side by side; the radula therefore being surrounded by epithelium on either side. Now the radula loses its connection with *a* and attaches itself to *b*, the teeth thus coming free. From there the radula is pushed along the pharyngeal wall in a dorsal direction. The radula is very strongly developed. Along both the lateral pharyngeal walls to a place close before the mouth-cavity the two broad radula-bands are found. Fig. 159 shows a section through the pharynx; the wall is composed of cubical epithelium, becoming higher more dorsally (*a*) and presenting more or less vesicular cells. The lateral walls are completely covered with the radula, which is flat with a few teeth. A similarly large radula has not yet been observed for Solenogastres. In fig. 150 the contour of the radula is indicated by a red line; in the pharynx the radula is 0.7 mm. long; the length of the portion in the radula-sac is 0.3 mm.; the entire length of the radula is therefore 1 mm.,

a gigantic size indeed. The radula is of a purely distichous character as is obvious from fig. 159; the radula-bands operate as a pair of scissors. Only the lateral pharyngeal walls carry the radula-bands; the dorsal wall is beset with long cilia, the ventral wall with shorter ones. The structure of the radula-sac is strange here, it being everywhere else a simple evagination of the ventral pharyngeal wall. Here on the contrary the case is complicated; the pharynx has a large ventral offset, but the radula is not directly formed in this; the distal wall is invaginated and it is only on the outside of the invagination that the radula is formed. The radula-sac is encircled by strong muscles, presenting a peculiar structure; at several parts they broaden and become transparent, with a great number of fine fibres. Sometimes the fibres are not present and in that case the muscles become wholly transparent; nuclei occur only sporadically (fig. 160). Around the pharynx these muscles are likewise met with (fig. 152).

The intestine has no regular septa, but is provided with irregular folds. A secretion consisting of large brownish-green granules is formed by the wall. Figs. 161—163 represent the course and opening out of the rectum.

The cloaca is a spacious cavity, lined with cubical epithelium. A considerable number of gills are found; about 20 gill-lamellae with strongly folded wall. In fig. 162 at *f* is a fold of the cloaca-wall, more proximally continuous with the latter. In fig. 163 the cloaca is slightly cross-shaped; it widens more proximally (fig. 164). 2 Strong muscular bundles connect the ventral cloaca-wall with the thin circular muscular layer under the hypodermis (fig. 165). The cloaca-opening is situated in a superficial furrow (fig. 163); here the cuticle is traversed by a great number of thin, closely packed spicula, the shape of which cannot be learned from my sections.

I do not give a reconstruction of the generative organs with their efferent canals, as the peculiar structure of the cloaca-ducts would interfere with the clearness of the illustration.

The cloaca-ducts are coloured yellow in my figures; for the sake of clearness the part running proximally is of a pale yellow, the part proceeding distally of a dark yellow. Both the genital glands, stretching a long way proximally contain mature eggs and spermatozoa. The cloaca-ducts pass out of the pericardium as narrow, strongly winding tubes, the right cloaca-duct being for this reason touched in fig. 166 3 times. More proximally they widen considerably and become sac-shaped (fig. 171). They do not carry any appendages; they themselves perform the duty of vesiculae seminales; numerous spermatozoa are contained in them. The wall is built up of cubical ciliated epithelium. In figs. 169 and 170 the part running proximally merges into the part running distally. The latter behaves likewise; it takes a winding course and is dilated at different points. They unite into the precloacal organ, which is large and extends far proximally (*pr. o.*). Here appendages are absent too. The structure of the portion of the cloaca-ducts running distally is in no way peculiar: cylindrical epithelium alternating with very slender cells; more proximally the glandular cells are finely granular with round nuclei at the base, whereas more distally and in the precloacal organ the glandular cells strongly secrete and are entirely filled with deeply staining large granules.

2 Small copulation-spicula are present (figs. 165, 166 *c. sp.*). They are short (0.2 mm.), but comparatively broad and attached to the ventral muscles of the body-wall by tolerably strong muscles. Probably they are partly calcareous and consist partly of a cuticular mass; it

is also possible that the spicula are hollow and merely consist of cuticular matter. A cubical epithelial layer surrounds them. Somewhat proximally from the cloaca-opening they appear on the outside; here next to the left spiculum a smaller one is observed (fig. 165).

The heart does not furnish any peculiarities. Fig. 162 represents 2 proximal offsets of the pericardium, the median walls of which are invaginated. Both invaginations unite and form the atrium (fig. 163 *a*), continuous with the ventricle, an invagination of the dorsal pericardial wall more proximally (figs. 164, 165 *v*). A dorsal and ventral blood-sinus are present. Around the gills a great number of blood-corpuscles are found, but no distinct blood-sinuses. The blood consists of a very finely granular liquid, staining pale red, in which the blood-corpuscles are found.

It is impossible to follow the course of the nerves in the anterior part of the body amid the numerous muscular fibres and glandular cells. The ganglion posterius superius is distinct (fig. 162), as well as the commissure between the ganglia posteriora inferiora; but the commissures between the ganglion posterius superius and the ganglia posteriora inferiora are absent.

The thick cuticle and the spicula remind us of Proneomenia, but the absence of papillae, the distichous radula, the structure of the salivary glands and the presence of gills are important points of difference. We see at once that it is related to Proparamenia and Paramenia, but from the former it directly differs on account of the distichous radula. The following are the points of resemblance it presents to Paramenia: the distichous radula, the gills, the absence of papillae in the integument, the presence of some papillae on the ventral side (cf. PRUVOT 4 fig. 61), and, though in a lesser degree, the structure of the cloaca-ducts. It is however advisable to keep both forms separate. In structure as well as in size the radula and radula-sac diverge from those of Paramenia. The salivary glands are also of a different structure and situation. In Paramenia the nervous system in the distal body-part is different and the cuticle much thinner. It cannot be denied however that there is a close relation between both forms.

Dondersia.

11. *Dondersia annulata* nov. spec. (Plate V, figs. 172—179).

Stat. 47. Bay of Bima (N. Sumbawa). 55 M. Upon Gorgonid. 1 Specimen.

Length-index 48. Pale brown with 30 white non-closed rings. 3 dorso-terminal sense-knots. 1 pair of vesicular appendages of the cloaca-ducts.

East-Indian Archipelago. 1 Specimen.

Fig. 172 represents the animal, 4 times enlarged. The length is 29 mm.; average diameter 0.6 mm.; the length-index is therefore 48. The animal has contracted very irregularly, the transverse sections being consequently of very different sizes. The colour is a pale yellowish-brown with a greyish gloss, owing to the spicula. 30 white rings occur, placed at irregular distances from each other, not closed, but open on the ventral side. The ventral groove is visible as a very narrow slit. The posterior part has a projecting lip (*p*), opening into the alimentary canal on the ventral side (*m*).

This form possesses a very thin cuticle and flat spicula. The latter are represented in fig. 173. The spicula of the body-wall are extremely minute, flat and more or less heart-shaped with a thick border, imbricated (A). Amongst these, though less numerous, spicula of shape *B* occur; spatula-shaped with border, or curved needles bluntly terminating. Along the ventral groove long spicula (C) are met with, which may also be flat, being in that case provided with a border. On the white rings no special spicula are observed. These shapes may be compared with those of Stylomenia Salvatori (PRUVOT 10 fig. 3) and Dondersia festiva (HUBRECHT 3 fig. 2). Papillae are entirely absent.

There are 3 extremely minute dorso-terminal sense-knots, looking like small elevations, which may be retracted or protruded by fine muscular fibres (figs. 178, 179 *d s.*).

The "Flimmerhöhle" is small. In the proximal part the "vordere Bauchdrüse" occurs: large transparent fibrillar glandular cells; the "hintere Bauchdrüse" which is much more developed and also met with along the ventral groove, has small cells, staining bright transparent red with carmine. The ventral groove, which runs as far as the cloaca, contains 1 large fold.

What has been observed with respect to Dinomenia Hubrechti and Rhopalomenia aglaopheniae holds good for this animal, viz. the mouth-cavity and the opening of the pharynx are separated from each other, a separation much more complete than in the before-mentioned species. In fig. 172 at *m* is the opening of the mouth-cavity; the name of mouth-cavity is justified on account of its carrying similar organs (cirrhi and "Mundleisten") as the mouth-cavity of the other Neomeniidae. Fig. 174 shows a transverse section through the proximal part of the body; the mouth-cavity is distinct; in the section fig. 175, which is a more distal one, the mouth-cavity is still visible (*m. c.*) whereas the opening of the pharynx is also visible.

The pharynx is a straight tube with a strongly folded wall, encircled by a strong circular muscular layer; numerous unicellular glands, which may form a compact mass, surround it (fig. 176, *p. g.*). There are 2 tubular salivary glands (*s. g.*) which take a winding course, and only extend a little distance distally (0.3 mm.). They are short tubes which unite, open out into the ventral part of the pharynx close before the radula, and are surrounded by unicellular glands, the contents of which are discharged into them. These glands cannot be distinguished from those of the pharynx, as is also the case with Dondersia festiva (HUBRECHT 3, figs. 10, 11). In Dondersia festiva and Stylomenia these salivary glands are likewise met with.

The radula, which is exceedingly small, is found somewhat more distally and consists of a few (4?) conical teeth, situated behind each other. Fig. 177 shows such a tooth, strongly enlarged; as they are placed in a slanting line, the part *b* may be considered as the pedicle of the following tooth, *a* being loose. The radula-sac is also very small, whereas any special muscles and cartilaginous cells are absent. A similar radula is only met with in Stylomenia Salvatori and Dondersia festiva, though the data of the latter are insufficient.

The part of the pharynx, next to the radula is not distinguished from the preceding portion in any respect and must therefore also be called pharynx; an oesophagus is absent. The pharynx unites with the proximal coecum and these form together the wide intestine, which is provided with regular coeca (fig. 178).

On comparing the nervous system with that of Stylomenia we observe the following

difference: a "nerf buccal moyen" and "externe" cannot be demonstrated. The cirrhi and "Mundleisten" are directly innervated from the cerebral ganglion; the sublingual ganglia on the contrary are clearly discernible (fig. 176). The commissures between the ganglion posterius superius and the ganglia posteriora inferiora are distinct; this is hoewever not the case with the commissure between the ganglia posteriora inferiora, which is not visible in my longitudinal sections.

The animal is mature. The cloaca-ducts are of a simple structure. The part, passing out of the pericardium proceeds first proximally as a straight, narrow ciliated tube, to bend afterwards and to run distally. The cloaca-ducts coalesce; the precloacal organ is large and opens into the cloaca. The part of the cloaca-ducts, running proximally, carries an appendage: a little stalked vesicle (fig. 178) which may be compared with the vesicula seminalis of Stylomenia.

Copulation-spicula and "organes en cordon" are absent.

The cloaca is a small cavity, which is continued far distally into the pointed extremity of the body.

Regarding the heart I cannot give any reliable data. From fig. 179 it is evident that the heart is divided into 2 parts (atrium and ventricle?), but from the longitudinal sections the exact structure cannot be made out.

I believe that I have sufficient grounds for placing this form under Dondersia. SIMROTH gives the following peculiarities for the genus Dondersia: "Gestreckt wurmförmig, cylindrisch; Kopfende kolbig verdickt. Kloakenöffnung ventral. Schwanzende darüber fingerförmig. Fussrinne biegt in die Kloake ein. Fuss vorhanden. Spicula nadel- oder schaufelförmig. Kiemen fehlen. Radula vorhanden. Ventrale und dorsale Speicheldrüsen. Längen-index 10".

With respect to this the following must be noticed. Dondersia festiva has not 4 but 2 salivary glands, the dorsal ones being absent. The latter are mentioned by SIMROTH because HUBRECHT makes mention of a gland, opening out into the pharynx and dividing into two more proximally (3 fig. 9 *k*). On looking very closely at fig. 9 of HUBRECHT we may observe however that the said gland is nothing but the mouth-cavity with the cirrhi and "Mundleisten"; HUBRECHT's sections, which were thoroughly examined by me, do not leave the slightest doubt on this point. The glands *k'* are present but must be regarded as accumulations of unicellular glands, also met with around the mouth-cavity elsewhere; of salivary glands there can be no question here. From this it follows that also in Dondersia festiva the mouth-opening and opening of the pharynx are separated from each other (cf. HUBRECHT's fig. 9 and my figure 175). But the ventral salivary glands of Dondersia festiva are structured like those of Dondersia annulata and take a similar course. The radula of Dondersia festiva is monoserial and consists of (4?) conical teeth behind each other. The structure of the pharynx and intestine is for both forms exactly alike. The structure of the cloaca-ducts may also be compared: the vesiculae seminales of Dondersia annulata may be compared with the tubes *l* and *l'* of Dondersia festiva (3 fig. 3); the stalked vesicles *A* of Dondersia festiva however are absent here. The byssus-gland of Dondersia festiva is not present here, but in my opinion this gland should be differently interpreted, being simply a proximal offset of the cloaca. The spicula of both forms are very much alike. The finger-shaped projection of Dondersia festiva is not found here, but an indication of

it is shown in fig. 179, where we observe that the cloaca extends far more distally. In Dondersia festiva dorso-terminal sense-knots also occur, 2 of which I can positively demonstrate. I hope to make close observations of Dondersia festiva afterwards, but I take it for certain that both forms are closely related.

Dondersia differs from Stylomenia in the structure of the nervous system and radula, and in the absence of the "organes en cordon", met with in Stylomenia. Yet there is, no doubt, a close relation with Stylomenia (cf. spicula, vestibulum, salivary glands, radula, cloaca-ducts of Stylomenia).

New diagnosis for Dondersia.

Dondersia Hubrecht.

Body long, length-index 10—48. 1 ventral fold. Spicula needle- or spatula-shaped, flat. Cuticle very thin, no papillae. Dorso-terminal sense-knots present. 1 pair of short ventral salivary glands, which unite before opening out into the pharynx. Radula small, monoserial (4? teeth). Mouth-cavity and pharynx-opening separated from each other. No copulation-spicula.

festiva Hubrecht.

Length-index 10. Violet; the proximal part of the body thickened. 2 Dorso-terminal sense-knots. 1 pair of tubular and 1 pair of vesicular appendages of the cloaca-ducts.

Naples.

annulata nov. spec.

Length-index 48. Pale brown with 30 white non-closed rings. 3 dorso-terminal sense-knots. 1 pair of vesicular appendages of the cloaca-ducts.

East-Indian Archipelago. 1 Specimen.

Chaetoderma.

12. *Chaetoderma Lovéni* nov. spec. (Plate VI, figs. 180—203).

Stat. 35. 8° 0'.3 S., 116° 59' E. 1310 M. In mud. 2 Specimens and a fragment.

Length 15—21 mm.; length-index of the two known specimens 20 and 34. Colour yellow-brown. Proximal part considerably thickened, distal part narrow but ending in a little knob. Extremely glittering owing to the flat and broad spicula. Radula with 1 large tooth, 2 sickle-shaped teeth, 1 slender oblong tooth and different smaller ones (?). 4 salivary glands. Liver very large, extending as far as the proximal part of the body. 3 Pairs of gill-retractors and 1 large protractor. From 8 to 12 gill-lamellae. Ganglion posterius superius situated in the pericardium.

East-Indian Archipelago. 3 Specimens.

Figs. 180 and 181 represent the two specimens. The length of the first specimen is 16 mm.; the diameter of the proximal part is 1.2 mm. and of the distal part 0.4 mm.; the length-index is therefore 20.

The length of the second specimen is 21 mm.; the diameter proximally 1 mm., distally 0.25 mm.; the length-index 34.

From the figures the difference in shape is clearly visible; the one specimen is short and broad, the other long and thin. This depends of course on the state of contraction and thus the length-index is only of comparative value.

The animals are considerably thicker at the proximal portion, a fact, due to the strongly developed liver (L), which is situated more proximally than in Chaetoderma nitidulum. The genital gland however extends far less proximally. A strong incision before the liver indicates the spot, where the retractors of the proximal end attach themselves to the body-wall. The proximal end is round and the mouth somewhat V-shaped. The distal part ends in a little knob. The colour is a pale yellow-brown, but the skin is transparent and permits the dark-coloured liver to show through, the animal being tinted consequently a dark violet. The spicula are distinctly visible and this accounts for the animal's extraordinary gloss. Nothing is perceptible of a dorso-terminal sense-organ.

The spicula are flat and broad (fig. 183 A), imbricated, with broad bases and somewhat tapered; they are finely striped, the stripes crossing each other and giving the spicula a peculiar design. At the posterior end long thin spicula occur (fig. 182), whilst around the mouth-opening very minute spicula are found, represented in fig. 183 B. Thus the spicula differ in shape from those of the known species of Chaetoderma. The cuticle is traversed throughout by spicula; at the posterior and anterior end the cuticle is thicker and there the spicula stand erect (fig. 184), in the middle region the cuticle is thinner whilst the spicula lie flat (fig. 185). The hypodermis has the thickness of 1 cellular layer, with large nuclei; the vesicular "Riesenzellen" (WIRÉN) are everywhere perceptible (fig. 184 R). Close behind the mouth-opening the cuticle is very thin; in one of the specimens spicula are entirely wanting there, the sections being at the same time not round but broadened on the ventral side (fig. 190); this peculiarity which is not presented by the other specimen, is most probably a consequence of contraction.

An extremely small dorso-terminal sense-knot is present at a spot, similar to that of Chaetoderma nitidulum.

Likewise as in Chaetoderma nitidulum the 3 muscular layers of the body-wall can only be indicated in the anterior part, whilst behind the head only the circular muscular layer is found. The 4 muscular regions formed by the longitudinal muscles can only be demonstrated in the posterior part of the body and are only slightly developed; for the rest the longitudinal muscles form 1 continuous layer. The separate muscular bundles of the proximal portion differ from those of Chaetoderma nitidulum. 2 Dorsal and some lateral retractors separate from the longitudinal muscles of the body-wall. The 2 dorsal ones (*m'*) divide each of them into 2 smaller bundles, which run proximally and ventrally to the right and left of the pharynx and attach themselves to the ventral body-wall in the anterior portion of the body; the lateral ones (*m*) take a similar course. Besides these there are ventral muscles (*m''*) which originate in the ventral wall and attach themselves to the ventral body-wall behind the mouth-opening (figs. 189, 190).

The gill-retractors are entirely different from those of Chaetoderma nitidulum (figs. 196—200). First there is a very strong muscle, running parallel to the gills, the fibres of which take a

longitudinal course (*g. m.*); it attaches itself to the distal body-wall and may be considered a protractor. Moreover there is a strong dorsal retractor (*d. r.*), which divides more proximally into two and attaches itself to the dorsal body-wall. Then there are also 2 lateral retractors (*l. r.*), attaching themselves to the lateral body-wall and 2 ventral ones, having the same relation to the ventral wall (*v. r.*).

The following must be noticed as regards the alimentary canal. Around the mouth-opening there is a broad cuticle ("Mundschild" WIRÉN) cf. figs. 186—188*c*; in one of the specimens this is almost entirely round, in the other it is somewhat V-shaped. The mouth can be retracted, the mouth-opening lying consequently in a cavity, as is the case with only one of the specimens (fig. 188*a*) and not with the other (fig. 187). Around the "Mundschild" a great number of spicula are implanted (fig. 183 B). The mouth-opening itself is slitlike and narrow.

The narrow pharynx has 4 small salivary glands, as in Chaetoderma nitidulum, but I cannot indicate any buccal glands. Its muscular layer is extremely thin. Fig. 189 represents the place where the pharynx passes into the intestine; the latter is provided with a small proximal coecum, as is the case in most of the Neomeniidae.

The radula deserves mention. Figs. 191 and 192 represent the radula of one specimen, figs. 193 and 194 that of the other (cf. KOWALEVSKY 13, fig. 1, 24—27 and WIRÉN 6[a] Plate V, fig. 15). The large radular tooth *dt* is present as well as the 2 large pieces *d*. The little chitinous teeth, directly obvious in the sections on account of their yellow colour, are clearly separated from them. In both specimens there are 2 large sickle-shaped cuticular pieces *a*, which support little curved teeth. Moreover in both specimens an oblong piece *b* is found. They also possess a number of fragments, the original situation of which we can no more trace of course. The resemblance they present to other forms of Chaetoderma will be discussed afterwards.

The intestine and the rectum do not furnish any peculiarities. As regards the liver, Chaetoderma Lovéni presents greater similarity to Chaetoderma nitidulum than to Chaetoderma radulifera. The liver is very large and extends from a place close behind the head to a good way distally (fig. 195 *l*). It is so strongly developed as to push away the intestine; the latter is present only in the shape of a very narrow tube (*i*). "Körnerzellen" as well as "Keulenzellen" (WIRÉN) can be demonstrated, but I am as yet not certain about their situation.

Of the nervous system I will only mention the cerebral ganglion and the ganglion posterius superius. Fig. 203 represents the cerebral ganglion *h. g.*; the nuclei are found at the periphery, the fibrillae more in the centre. To this cerebral ganglion 6 smaller ganglia are attached, 4 of which are lateral (*3*, *4*, *5*, *6*) and 2 proximal (*1*, *2*). The shape of the cerebral ganglion corresponds to that of Chaetoderma nitidulum, whilst the 6 round ganglia are called by WIRÉN the "lobi laterales and anteriores". For Chaetoderma Lovéni however the separation between the latter and the cerebral ganglion is much more distinct.

Around the mouth-opening numerous buccal ganglia are met with (figs. 186—187).

We must notice the situation of the ganglion posterius superius, which is found dorsally to the rectum (fig. 199). It is a remarkable fact, that the two distal offsets of the pericardium unite and enclose the ganglion posterius superius, which lies therefore in the pericardium (fig. 201 *G. p. s.*).

Afterwards I hope to give a more detailed account of this for a new species of Chaetoderma (Chaetoderma canadense) where even the ganglion posterius superius is found in the heart itself.

The heart consists of 1 atrium, which has a double origin, on account of 2 invaginations of the wall of the distal pericardial offsets, which unite (fig. 201 *a*). This atrium is spacious and provided with a tolerably thick wall. The ventricle on the contrary is an invagination of the dorsal pericardial wall and in communication with the atrium. My sections do not permit of a more accurate observation of the heart.

The gills, which are broad and short, contain 8 or 12 gill-lamellae only.

The animals are males and the genital glands are fully mature. The latter and the cloaca-ducts do not offer any peculiarities.

Chaetoderma Lovéni differs in many respects from the species of Chaetoderma already known. It is clearly distinct from Chaetoderma nitidulum on account of its radula with the numerous teeth, and it differs likewise from Chaetoderma radulifera, which possesses a much more developed radula. The radula of Chaetoderma gutturosum is more closely related to that of Chaetoderma Lovéni, though there is a difference between the two. Besides the shape of the spicula shows that we have to deal with a different species here.

13. *Chaetoderma Wiréni* nov. spec. (Plate VI, figs. 204—210).

Stat. 241. 4° 24'.3 S., 129° 49'.3 E. 1570 M. 1 Specimen.

Length 11 mm. Length-index of the only badly preserved specimen 11. Proximally slightly broader than distally. Colour greenish-brown. Spicula larger than those of Chaetoderma Lovéni and more lance-point-shaped. Radula with 1 large tooth, 2 chitinous side-pieces, 2 chitinous sickle-shaped teeth and some smaller ones (?). 4 salivary glands. Liver large as in Chaetoderma nitidulum. About 20 gill-lamellae.

East-Indian Archipelago. 1 Specimen.

The length is 11 mm.; the diameter proximally over 1 mm., distally 1 mm. The length-index is 11. The proximal end is bluntly cut off and the animal glitters owing to the thin spicula. At the distal end there are also a number of straight, long spicula. The colour is a greenish-brown. The mouth-opening is round and the liver shows through distinctly. Of the internal structure I can give only very unsatisfactory information; the anterior portion has been well-preserved, but the case is different with the posterior part, the organs of which are hardly perceptible.

Fig. 204 represents the animal 4 times enlarged. The dorso-terminal sense-organ is large and extends as in Chaetoderma productum as far as the cloaca-border.

In appearance Chaetoderma Wiréni differs greatly from Chaetoderma Lovéni. When only slightly enlarged the differently shaped spicula become directly obvious; they are much larger here. In fig. 205 *A* the spicula of the body-wall are 75 times enlarged and show the difference from fig. 183, also 75 times enlarged. The shape of the spicula is more pointed here; they are ribbed length-wise. Fig. 205 *B* represents a spiculum of the posterior end, *C* the spicula around the mouth-opening, present in great numbers. The cuticle is thicker than that of

Chaetoderma Lovéni; on looking at fig. 208, which represents a part of it, 125 times enlarged; the entire difference from fig. 185 (215 ×) is directly noticed.

Here also the longitudinal muscular bundles do not form 4 muscular regions but 1 thin continuous layer. The retractors *m*, *m'* and *m''* (figs. 206, 207) are also present here, but they are much more strongly developed than they are in the preceding species.

The structure of the organs of the proximal part corresponds in some degree with that of Chaetoderma Lovéni. The pharynx has strongly contracted, in consequence of which the mouth-opening is retracted and lies in a cavity (cf. figs. 188 and 206). The salivary glands are present but I cannot demonstrate any buccal glands. I must make mention of the fact that here too the intestine carries a small proximal coecum.

The structure of the nervous system coincides with that of Chaetoderma Lovéni; the sublingual commissure is clearly discernible and provided with some small nerve-knots (cf. WIRÉN, 6ª pl. VII, fig. 1).

The radula is noteworthy (figs. 209—210). The large tooth *dt* is present, as well as the side-pieces *d*, which here are visibly provided with a chitinous covering. The 2 sickle-shaped pieces *a* are also easily discernible and consist merely of chitine. The other pieces are fragments, the original situation of which cannot be traced. The narrow oblong piece *b* present in Chaetoderma Lovéni is wanting in Chaetoderma Wiréni, which has only curved teeth; therefore there is a difference between the two forms in the structure of the radula.

The liver is large and of a similar structure to that of Chaetoderma nitidulum. The genital gland is mature and compactly filled with spermatozoa. Of the organs of the posterior body-part hardly anything has been preserved.

The number of the gill-lamellae can be indicated with certainty and is about 20.

Chaetoderma Wiréni differs in the first place from the known species of Chaetoderma on account of the spicula, the shape of which may be compared with that of Chaetoderma nitidulum, gutturosum and radulifera. Yet it has to be kept distinct from these three forms on account of the structure of the radula.

III. ON THE RADULA OF CHAETODERMA.

(Plate VI, figs. 211—216).

Especially after what has recently been published by KOWALEVSKY (13) it may be desirable to give a short account of what is known of the radula of Chaetoderma. The fact, that the radula of Chaetoderma is composed of different teeth is not new, when we remember what HUBRECHT (3 pag. 5 note) has written about it. Three years ago already I examined different species of Chaetoderma and as I always met with a radula, consisting of different teeth I tried to indicate one for Chaetoderma nitidulum too. I isolated the radula of this form with Eau de Javelle, and like KOWALEVSKY I found the 2 small teeth situated upon the large one. Though

I have nothing to mention about Chaetoderma nitidulum. I will here write down my observations of the radula of the other forms, a fuller description of which I hope soon to publish; for comparison is facilitated when all the figures with relation to the radula of Chaetoderma are within our reach.

Figs. 214 and 215 represent sections of a species of Chaetoderma of unknown origin. There being many points of conformity I feel justified in classing this specimen among Chaetoderma Lovéni. The radula corresponds with that of Chaetoderma Lovéni; the large tooth *dt*, broken here, the side-pieces *d*, the sickle-shaped teeth *a* and more especially the narrow oblong piece *b*, broken here also.

Figs. 212 and 213 represent the radula of a species of Chaetoderma of unknown origin (present of Rev. NORMAN) which for the rest does not differ much from Chaetoderma nitidulum. The large tooth *dt* and the side-pieces *d* are present; it is distinctly visible that the small chitinous radula consists of a heart-shaped centre, 2 large and 2 smaller curved teeth and some small ones.

Fig. 211 represents the radula of a species of Chaetoderma from Port-Hood (Canada) which I intend to call Chaetoderma canadense. After isolation with Eau de Javelle the large radular tooth is found whilst the 2 very small teeth noticed for Chaetoderma nitidulum are also present; the latter are oblong, somewhat spindle-shaped, slightly curved but not sickle-shaped. In the isolating the small teeth have changed places, but probably their positions were similar to those of the teeth of Chaetoderma nitidulum (cf. KOWALEVSKY 13, fig. 27). To render a comparison between the two radulas possible, I also give that of Chaetoderma nitidulum, after isolation with Eau de Javelle (fig. 216); here the little teeth have also changed places: in "canadense" there is however more difference in size between the large tooth and the small ones, than there is in "nitidulum".

For Chaetoderma we can therefore distinguish 3 types of a radula:

1° 1 large tooth upon which 2 smaller teeth are placed: Chaetoderma nitidulum, productum and canadense.

2° 1 large tooth upon which there is a row of teeth: Chaetoderma gutturosum, Lovéni, Wiréni and the above mentioned species of NORMAN (and "militare"?).

3° Several rows of 5 teeth, one behind the other. No large tooth: Chaetoderma radulifera.

Now we will look, whether there is any relation between these 3 groups. In "radulifera" there are rows which consist of 5 teeth, but what do we observe in group 2? For this let us compare KOWALEVSKY's figures 24 and 26 with my figures 191—194. The large tooth *dt* is present in both forms; my side-teeth *d* may be compared with *d* and *d'* of "gutturosum"; in "Lovéni" there are however only 2 such pieces. On comparing the sickle-shaped pieces *a* we notice an important difference; whilst in "gutturosum" the pieces *a* form a closed ring, they are in "Lovéni" visibly provided each with a small chitinous tooth; in the sections these yellow teeth are clearly distinct from the evidently cuticular sickles. KOWALEVSKY does not mention anything about this, neither does he say whether the sickle-shaped pieces of "gutturosum" consist of chitine or not. Upon *d* a chitinous tooth is likewise met with; "gutturosum" is however without the rectangular piece *b*. We may speak here too of a row of 5 teeth; 2 chitinous

teeth resting upon *d*, 2 upon the sickles *a* and a rectangular one *b*. This row of teeth does not correspond neither with the first, nor with the second row of "gutturosum" (KOWALEVSKY 13, fig. 25, pag. 276—277).

Though there are some points of resemblance a comparison is extremely difficult on account of my sections being seriously injured. From the structure of the large tooth *dt*, which in both species is somewhat fork-shaped, it is evident, that there may be some relation.

The question also arises whether KOWALEVSKY is justified in calling the pieces *d* and *d'* teeth; is it not possible that they may be compared just as well with the mandibulae of "radulifera" as with the cuticular "Leisten" of "nitidulum" (mandibulae, KOWALEVSKY). The same is the case with the large tooth *dt*; it appears to me that we have good reason not to consider it as belonging to the radula and to compare it with the side-pieces (mandibulae?) *d* and *d'*.

In account of the piece *b* (fig. 192) the radula of "Lovéni" approaches more closely that of "radulifera" where a similar piece is found in the middle of the row of teeth (KOWALEVSKY 13, fig. 9 pc). Fig. 191 shows that there may have been still another row of teeth; an oblong piece *b*, which may better be compared with the piece *pc* of "radulifera", is likewise present. It is evident therefore that the radula of "Lovéni" may be compared with that of "radulifera" and "gutturosum".

The radula of "Wiréni" presents other peculiarities; here the large tooth *dt* is of the ordinary structure, but the two pieces *d* are, no doubt, chitinous, that is, surrounded by a chitinous mantle. The latter may be compared with the large tooth *dt* of "nitidulum" and "canadense" which also consists of cuticular matter, surrounded by a thin chitinous layer, rendering the tooth very brittle after isolation (cf. fig. 216). Of this radula the sickles *a* are moreover quite chitinous and differ therefore from those of "Lovéni" and "radulifera"(?), which are cuticular, whilst the teeth they carry are chitinous. For the rest there is nothing more to be said of the radula of "Wiréni".

We may compare the radula of the species of Chaetoderma (present of Rev. NORMAN) with that of "radulifera", but a closer resemblance exists between it and "Lovéni"; the middle piece *b* is heart-shaped but the 2 sickles are wanting; the teeth *e* have been situated perhaps upon the side-pieces *d* and the teeth *a* may be compared with those on the sickles of "Lovéni"; these are however mere suppositions.

The radula of "nitidulum", "productum" and "canadense" may have developed from a radula like that of "Wiréni"; the little teeth have disappeared; only the 2 chitinous sickles remain, whilst the large tooth and the side-pieces are still present.

At any rate it is evident, that the radula of Chaetoderma is of great importance: any contribution to its knowledge is heartily welcome. A division into a number of smaller genera may be expected in the future; the liver also presents important differences. Chaetoderma radulifera with its well-developed radula and extremely small liver is perhaps the most primitive form; the other forms have developed with a rudimentary radula and strongly developed liver [1]). The question to which species of the Neomeniidae Chaetoderma is related, must still remain unanswered.

1) When this article was passing through the press, I examined a new species of Chaetoderma, brought home by the Challenger-Expedition, which I intend to call Chaetoderma Challengeri. This species a description of which I hope soon to publish, has a purely distichous radula, consisting of many rows of teeth, one behind the other, and a well-developed radula-sac. The liver on the contrary is hardly developed at all.

IV. CONCLUSION.

Recapitulating the contents of the preceding pages, we come to the conclusion that the Siboga-Expedition has been able to secure 65 specimens of Solenogastres, belonging to 8 genera (4 new genera) and to 12 species (all of them new), viz;

Proneomenia Weberi	11 specimens	Depth 22—1633 M.
Proneomenia longa	2 specimens	Depth 1158 M.
Dinomenia Hubrechti	2 specimens	Depth 73 M. and pelagic
Dinomenia verrucosa	11 specimens	Depth 32—112 M.
Proparamenia bivalens	2 specimens	Depth 82 M.
Rhopalomenia indica	28 specimens	Depth 18—560 M.
Rhopalomenia debilis	1 specimen	Depth 75—94 M.
Hemimenia intermedia	2 specimens	Depth 69—75 M.
Cyclomenia holosericea	1 specimen	Depth 918 M.
Dondersia annulata	1 specimen	Depth 55 M.
Chaetoderma Lovéni	3 specimens	Depth 1310 M.
Chaetoderma Wiréni	1 specimen	Depth 1570 M.

The different depths do not present any peculiarities on comparison with those of the known species; the greatest depth of Proneomenia Weberi (1633 M.) however, exceeds that of the species of Proneomenia already described. This depth has only been surpassed by that of Chaetoderma nitidulum (1250 fathoms, SIMROTH 7, pag. 208). PELSENEER (12) mentions as the greatest depth 3088 M. This is based on an error. At St. 202 a depth of 3088 M. was indeed met with; but in the fishing the trawl was made no use of; only the horizontal cylinder was used, the specimen of Dinomenia Hubrechti, caught in this case, being consequently found living free at the surface, and apparently leading a pelagic life, which has hitherto not been noticed among Solenogastres.

In various respects our knowledge of the Solenogastres has been extended by the Indian forms.

There is good reason for dividing the Neomeniidae into 2 groups:

A) Those with a thick cuticle, papillae, and long pointed spicula in many layers one above the other.

B) Those with a thin cuticle, without papillae, with flat, imbricated spicula.

Both groups must remain distinctly separated, only Paramenia might be called intermediate, though it is more closely related to group *B* than to group *A*. I am of PRUVOT's opinion in considering the type of group *B* the most primitive one.

Taking the radula however as the principal point of comparison, we notice 3 groups:

C) Forms with polystichous radula.

D) Forms with distichous radula.

E) Forms without a radula. All these forms may be considered as having sprung from forms with radulas and should be considered specialized forms.

All forms of group *A* correspond with those of group *C* with the exception of Dondersia and Macellomenia; *B* and *D* correspond likewise.

The question arises now, whether there is any relation between both groups and whether there may be transition-forms between the forms with a thick cuticle, pointed spicula, papillae and a polystichous radula, and forms with a thin cuticle, flat imbricated spicula, a distichous radula, and without papillae.

Such a transition-form has been described in the first place by PRUVOT for Stylomenia (10): the radula of this form may have originated from that of Ismenia, whilst the radula of Stylomenia may have given rise to a form like that of Amphimenia and Proneomenia vagans Kow. & Mar. In that case the integument and the spicula of Amphimenia must have developed from those of Stylomenia; a transition-form between the two is wanting.

Stylomenia also presents points of affinity to other forms. In the first place to Dondersia, of which the radula has 1 purely conical tooth, the distichous character of which can no longer be recognised, whilst Dondersia is in its turn related to Myzomenia and Nematomenia.

Moreover there is some relation between Stylomenia and Hemimenia on account of the thin cuticle, but more especially on account of the "organes en cordon". A third line of development leads therefore in the direction of Hemimenia and Neomenia.

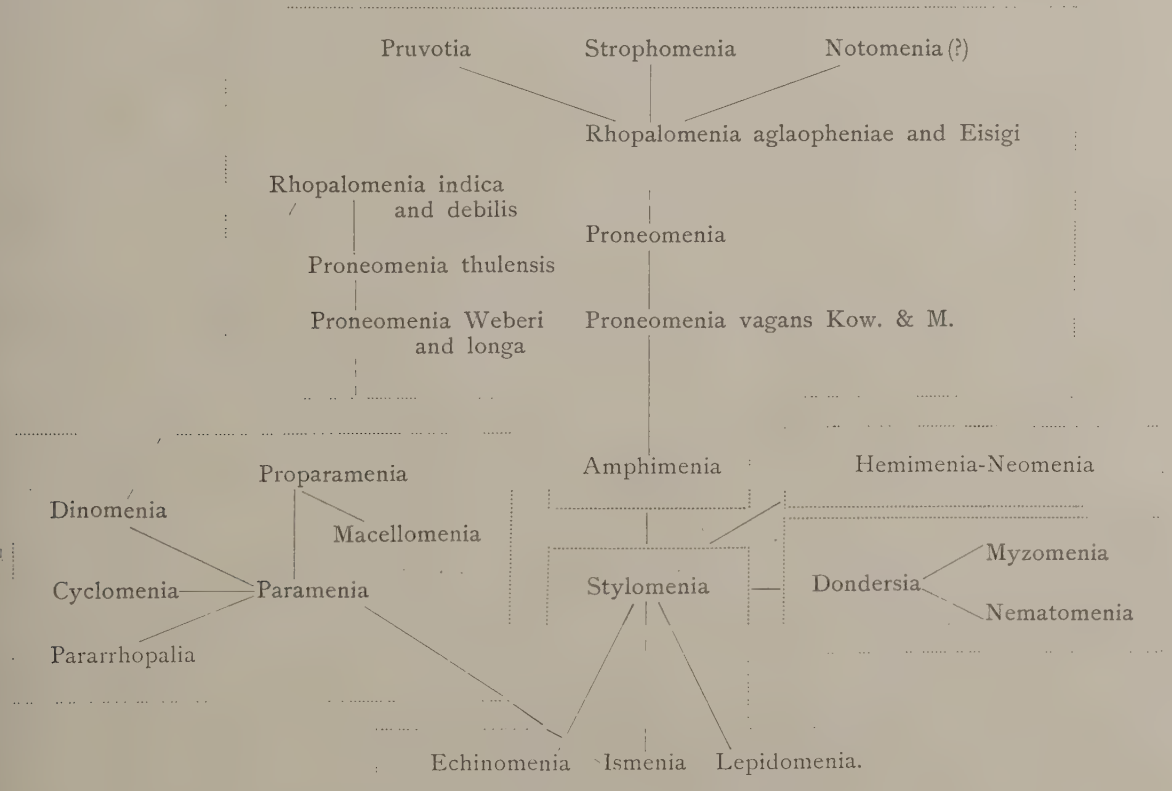
Another group may have developed from Ismenia in the direction of Paramenia. The cuticle of Paramenia is thicker than that of Stylomenia but the papillae are still absent; the spicula are long and thin but the radula is distichous. A close relation of Paramenia is Proparamenia; the radula of the latter form is however monoserial. A close observation of this radula will still reveal its origin from a distichous radula (cf. fig. 88); when the teeth of a distichous radula approach each other and broaden whilst the basal ends fuse into each other, a radula like that of Proparamenia may originate. From the latter form radula-forms like those of Macellomenia and Proneomenia may spring. PRUVOT mentions that in forms with a distichous radula the salivary glands open out separately, while in those with a polystichous radula the salivary glands unite before opening out into the pharynx. This view correct at the time he wrote, is no longer of value. Forms with a polystichous radula like Proparamenia, Proneomenia Weberi, Proneomenia longa and Proneomenia thulensis have 2 salivary glands, which remain separated. PRUVOT says (10, pag. 486): "on conçoit que si les orifices (des glandes salivaires) viennent à se rapprocher, il en sera de même des deux rangées de crochets comprises entre eux, et quand les orifices se seront fusionnés en un, seul les odontoblastes produiront une bandelette unique". This holds good for forms like Proneomenia vagans, Dondersia and others but it is impossible that e. g. in Proneomenia Weberi it should be because of the salivary glands, merging clearly separated into the pharynx that the polystichous radula has sprung from a distichous radula. The polystichous radula of these forms is far better explained by supposing it to have sprung from the radula-forms of Proparamenia and Paramenia. The presence of the 2 broad radular teeth, which in Proneomenia Weberi and longa are found in the middle of the radula (cf. fig. 17, 28) reminds me of the tooth of Proparamenia and is in favour of his view. From this circumstance it follows that it would be better perhaps not to class the 2 above mentioned forms with the other species of Proneomenia as 1 genus. Especially as far as the radula of Proneomenia is concerned, our knowledge is still insufficient,

but it is not improbable however that in the future the genus Proneomenia will be divided into smaller genera. As Proneomenia Weberi and longa show the principal characteristics of the genus Proneomenia (polystichous radula, structure of the integument, 2 salivary glands, no gills), a division of this genus should as yet not be recommended.

What has been noticed in Proneomenia, holds good for Rhopalomenia. Whilst in Rhopalomenia aglaopheniae and Eisigi the loss of the radula points towards their origin from species of Proneomenia, it is much more probable that Rhopalomenia indica and debilis are related to a form like Dinomenia. The numerous receptacula seminis of Rhopalomenia indica point towards some relation with Dinomenia verrucosa, just as the rudimentary radula-sac of Rhopalomenia debilis points to a certain relation with Dinomenia, which has a distichous radula. However a relation between Rhopalomenia indica and Proneomenia thulensis is also very well possible. The absence of a radula in Pronomenia and Dinomenia may give rise to forms closely resembling each other both of them with a thick cuticle, pointed spicula in many layers, 2 long salivary glands, no radula.

Proparamenia and Paramenia differ considerably in the structure of the integument. A transition-form between the two is not known, but the possibility of such a form is proved by Cyclomenia, which has a thick cuticle and needle-shaped spicula, but is without papillae. For the rest Cyclomenia and Dinomenia are related to Paramenia, and show that the integument may develop in the direction of Proneomenia, whilst the radula remains distichous.

As a consequence of these facts, the relation between the known Neomeniidae may be established as follows:



About the relation with Chaetoderma nothing can as yet be determined, which might be expected from all I have told of its radula. The relation with Myzomenia of which THIELE makes mention, can no more be demonstrated for Chaetoderma, on account of its very complicated radula.

In the preceding pages I have tried to explain the different relations of the Neomeniidae; for phylogeny my scheme is of no value of course. Perfect certainty can be obtained only after repeated and close investigations of the known forms and of new ones which will probably be discovered. In this respect the rich collection, brought back by the Siboga-Expedition, may be considered an important extension of our knowledge of the Solenogastres.

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CORRIGENDA.

Page 3 line 3. *for* cuticula *read* cuticle.
Page 4 line 36 *for* discernable *read* discernible.
Page 5 line 12 *for* cuticula *read* cuticle.
Page 6 line 1. *for* Neomenidae *read* Neomeniidae.
Page 6 line 8. *for* cuticula *read* cuticle.
Page 6 line 12, 15. *for* continuous in *read* continuous with.
Page 9 line 28. *for* sinus *read* sinuses.
Page 9 line 39. *for* cuticula *read* cuticle.
Page 11 line 34. *for* cuticula *read* cuticle.
Page 15 line 6, 8. *for* cuticula *read* cuticle.

PLATES.

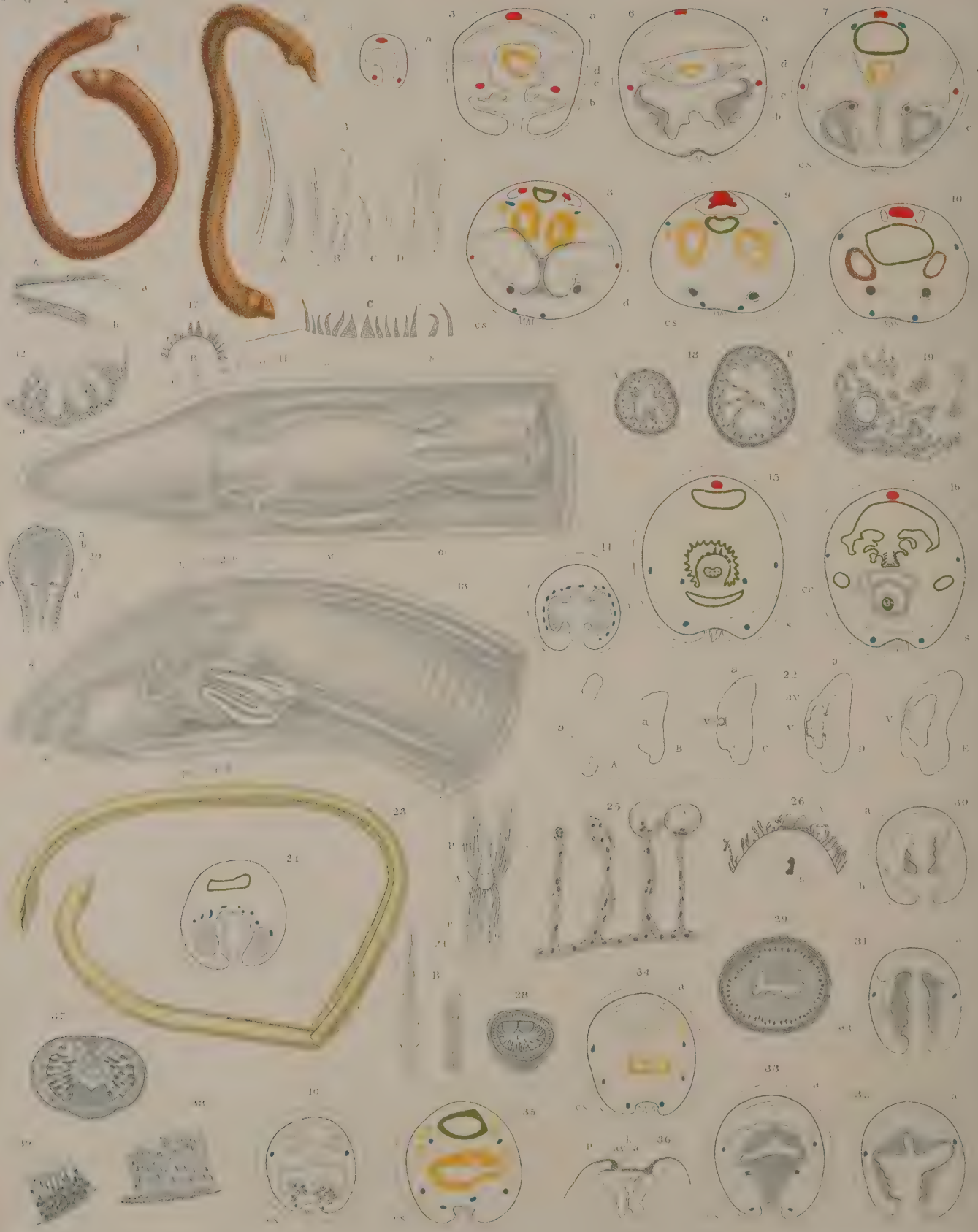

Fig. 28, 37, 38, 39 Hanau cet. Nierstrasz del.

Chromolith. P. W. M. Trap Leiden.

PLATE I.

Nervous system blue. Alimentary canal green. Heart and blood-sinuses red.
Cloaca-ducts yellow. Appendages of the cloaca-ducts brown.
Integument, cloaca-wall, copulation-spicula, blood-gland, pericardium and muscles black.

Fig. 1—22. Proneomenia Weberi.

Figs. 1, 2. Proneomenia Weberi, 4 ×, drawn from spirit-specimens.
Fig. 3. Spicula 125 ×. *A* of the body-wall, *B* cloaca-spicula, *C* spicula from the hinder body-region, *D* along the ventral groove.
Figs. 4—10. Schematic sections along the lines *AB*—*NO* of fig. 11. 28 ×. See text.
Fig. 11. Reconstruction out of transverse sections of genital glands, pericardium, cloaca-ducts, part of the cloaca and digestive canal. Dorsal view. *c* copulation-spiculum. 28 ×.
Fig. 12. Epithelium of the wall of the cloaca-pouch *b* (cf. fig. 5), *a* cavity in which a cloaca-spiculum. 215 ×.
Fig. 13. Reconstruction of the anterior part out of longitudinal sections. *p* wall of the pharynx, *a* part of the mouth-cavity, enclosed by the "Mundleisten", in which the cirrhi are found, *b* muscles of the pharyngeal fold. 28 ×.
Figs. 14—16. Schematic transverse sections of the anterior part, cf. the lines *AB*—*EF* of fig. 13. *S* septum, *cc* cartilaginous cells of the radula. 28 ×.
Fig. 17 *A*. A longitudinal section through the radula. *a* radula-sac, *b* epithelial pouch. See text. 37 ×.
B. A transverse section; the greater part of the teeth are broken. 37 ×.
C. Row of teeth of the radula, isolated with Eau de Javelle. 88 ×.
Fig. 18 *A*. Transverse section through a cloaca-duct.
B. Transverse section through the vesiculae seminales. 190 ×.
Fig. 19. Transverse section through a copulation-spiculum with its muscular bundles. 125 ×.
Fig. 20. Longitudinal section through the base of a copulation-spiculum (see text). 150 ×.
Fig. 21 *A*. Idem. *p* protractors, *r* retractors. 28 ×.
B. Point and middle piece of a copulation-spiculum, isolated with Eau de Javelle. 125 ×.
Fig. 22. 5 Transverse sections through the pericardium with the heart.
Aa the two distal pericardial invaginations, forming together:
Ba the atrium.
Cv the ventricle.
Dav the right atrio-ventricular opening, with little sphincter. 56 ×.

Figs. 23—40. Proneomenia longa.

Fig. 23. Proneomenia longa, 4 ×, drawn from the spirit-specimen.
Fig. 24. Transverse section through the mouth-opening, along line *AB* of fig. 27. 24 ×.
Fig. 25. Papillae of the integument. 315 ×.
Fig. 26 *A*. Transverse section through the radula,
B. A hooked tooth. 190 ×.
Fig. 27. See plate II. Reconstruction of the anterior part, out of transverse sections. *a* part of the mouth-cavity filled with cirrhi; *b* epithelial pouch of the radula. 24 ×.
Fig. 28. Transverse section through the radula in pouch *b* (cf. fig. 17 A). 190 ×.
Fig. 29. Transverse section somewhat more distally; the teeth have disappeared; cuticular matter is formed. 190 ×.
Figs. 30—35. Schematic transverse sections through the posterior extremity. 28 ×. *ag* preanal gland, *cs* copulation-spiculum.
Fig. 36. Transverse section through the heart. *p* pericardium, *a* atrium, bilobed, *k* invagination of the dorsal pericardial wall, forming the ventricle more proximally, *av* left atrio-ventricular opening with sphincter. 88 ×.
Fig. 37. Transverse section through the radula-sac. 215 ×.
Fig. 38. Epithelium of the dorsal cloaca-wall. 388 ×.
Fig. 39. Epithelium of the lateral cloaca-wall. 215 ×.
Fig. 40. Transverse section through the posterior end of the second specimen, cf. fig. 33. *cs* small copulation-spicula. 25 ×.

Fig. 41, 68, 69 Hanau; 60 Huysmans cet. Nierstrasz del.

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PLATE II.

Colours: see Plate I.

Fig. 27: see Plate I.
Figs. 41—56. Dinomenia Hubrechti.

Fig. 41. Dinomenia Hubrechti, 4 ×, from a spirit-specimen.
Fig. 42. Spicula, 316 ×. *A* of the body-wall, *B* along the ventral groove.
Fig. 43. Reconstruction of the anterior extremity out of transverse sections. 39 ×. *a* mouth-cavity, (cirrhi not indicated) *b* cavity in which the pharynx opens out; *c* dorsal and proximal coecum.
Figs. 44—47. Schematic transverse sections along the lines *AB*—*GH* of fig. 43. *c* muscle separating cavity *a* and cavity *b*, *cc* cartilaginous cells. 39 ×.
Fig. 48. Transverse section through the radula. 148 ×. *In* muscle, *sg* salivary gland.
Fig. 49. Radula-teeth and fragments. 430 ×.
Fig. 50. Transverse section through the radula-sac. 215 ×. *A* more proximally, *B* more distally.
Fig. 51. Reconstruction of the posterior extremity, out of transverse sections, dorsal view. *a* vesicula seminalis, *b* receptaculum seminis, *cs* copulation-spiculum. 23 ×.
Figs. 52—55. Schematic transverse sections along the lines *AB*—*GH* of fig. 51. 23 ×. *cs* copulation-spicula.
Fig. 56. 6 Transverse sections through the pericardium and the heart. 75 ×. *a* and *b* invaginations of the distal and dorsal pericardial wall, forming together the atrium *b* + *a*. *c* invaginations of the dorsal pericardial wall which form the ventricle, *d* see text.

Figs. 57—59. Proneomenia sp.

Fig. 57. Reconstruction of the posterior end out of transverse sections. Dorsal view. *a* proximal offset of the cloaca, *b* coecum of the cloaca-ducts, *c* copulation-spiculum. 40 ×.
Figs. 58—59. Schematic transverse sections along the lines *AB*—*CD* of fig. 57. *cs* copulation-spiculum. 37 ×.

Figs. 60—75. Dinomenia verrucosa.

Fig. 60. Dinomenia verrucosa, drawn from life by Mr. HUYSMANS. Natural size.
Fig. 61. A young specimen, 4 ×, drawn from a spirit-specimen.
Fig. 62. Spicula, 125 ×. *A* of the body-wall, *B* and *C* along the ventral groove, *D* around the cloaca-opening.
Fig. 63. Reconstruction of the anterior part of the specimen of fig. 60 out of transverse sections. 4 ×. *a* part of the mouth-cavity filled with cirrhi, *b* little dorsal coecum, *c* fold of the dorsal wall of the mouth-cavity, *d* ventral coecum, *r* radula-sac, *e* tubular ventral appendage of the pharynx, *sg* salivary gland, *gg* genital gland, *mm* pharyngeal muscles.
Fig. 64. Transverse section through the appendage *e* and the salivary gland *sg*. 88 ×.
Figs. 65—67. Radula-teeth and fragments. 88 ×.
Fig. 68. Transverse section through the radula and radula-sac, *b* basal-membrane, *t* tooth. *c* pedicle. 39 ×.
Fig. 69. Transverse section through the radula at the point where it bends into the radula-sac. 50 ×.
Fig. 70. As fig. 63, anterior part of a young specimen. 12 ×. *o* opening of the ventral pharyngeal appendage.
Figs. 71—77. Schematic transverse sections through the anterior part, along the lines *AB*—*NO* of fig. 63. 4 ×. *rs* radula-sac, *r* radula.

Fig. 83 Hanau cet Nierstrasz del.

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PLATE III.

Colours: see Plate I.

Figs. 76—82. Dinomenia verrucosa.

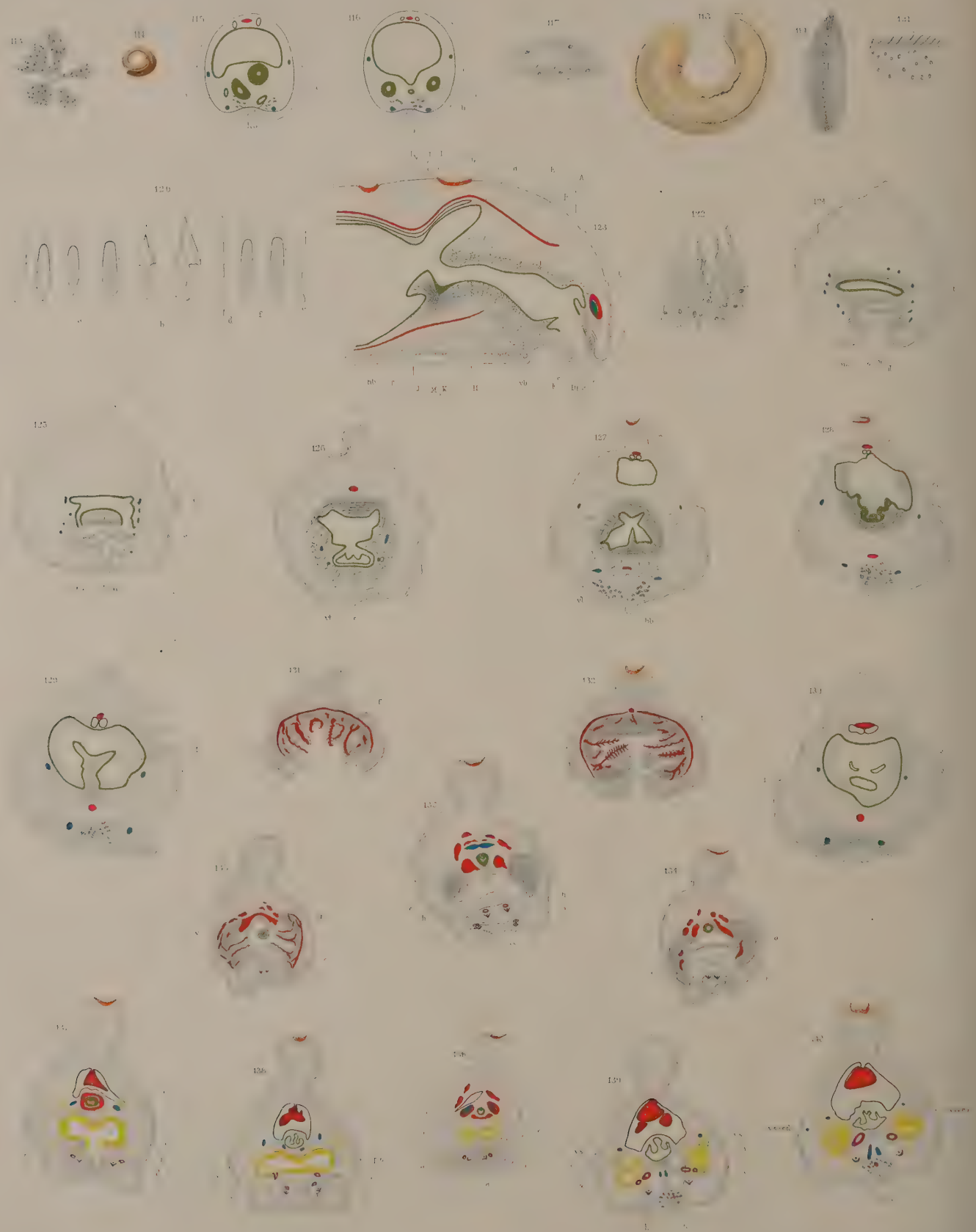
Figs. 76, 77. see Plate II.
Fig. 78. Reconstruction of the posterior extremity of a young specimen. 18 ×. Dorsal view.
Figs. 79—82. Schematic transverse sections through the posterior extremity of another specimen, along the lines *AB*—*GH* of fig. 78. 4 ×.
figs. 81, 82. *a* atrium, *v* ventricle.

Figs. 83—100. Proparamenia bivalens.

Fig. 83. Proparamenia bivalens, 4 ×, from a spirit-specimen.
Fig. 84. Spicula 316 ×. *A* of the body-wall, *B* along the ventral groove.
Figs. 85, 86. Schematic transverse section through the anterior extremity along the lines *AB*—*CD* of fig. 87. 30 ×. *sg* glandular part of the salivary glands, *sd* salivary ducts, *m* muscle.
Fig. 87. Reconstruction of the anterior extremity out of transverse sections, 30 ×. *o* opening of the right salivary duct *sd*.
Fig. 88. Radula-teeth, 215 ×.
Fig. 89. Transverse section through pharynx and radula *r*, 88 ×.
Fig. 90. Transverse section through the radula-sac, *r* radula, *rt* fragments of radula-teeth (?), *cc* cartilaginous cells, *ph* pharyngeal wall, 88 ×.
Fig. 91. Pharyngeal glands, 88 ×.
Fig. 92. Transverse section through a salivary gland, 88 ×. *e* epithelium of the salivary duct *sd*, *m* circular muscle, *sg* glandular part.
Fig. 93. Reconstruction of the posterior extremity out of transverse sections, 30 ×. *rs* receptaculum seminis.
Figs. 94—99. Schematic transverse sections along the lines *AB*—*LM* of fig. 93. *c* cloaca, *a* atrium, *ds* dorsal sinus, *v* ventricle, 30 ×.
Fig. 100. 5 Sections through the pericardium and the heart. 40 ×. *gs* gill-sinus, *a* atrium, *v* ventricle, *ds* dorsal sinus.

Figs. 101—112. Rhopalomenia indica.

Figs. 101—103. Rhopalomenia indica, drawn from spirit-specimens. 4 ×.
Fig. 104. Spicula 50 ×. *A* of the body-wall, *B* around the cloaca-opening, *C* along the ventral groove.
Fig. 105. Reconstruction of the posterior extremity out of longitudinal sections, dorsal view. 18 ×.
Fig. 106. Section along the line *EF* of fig. 105. 7 ×.
Figs. 107, 108. Sections along the lines *CD*—*AB* of fig. 105. 11 ×. *cg* cloaca-groove.
Fig. 109. Reconstruction of the anterior extremity out of longitudinal sections. 18 ×. *sg* salivary duct,
Figs. 110, 111. Schematic transverse sections along the lines *AB*—*CD* of fig. 109. 18 ×. *sg* sublingual commissure.
Fig. 112. Transverse section through a salivary gland. 88 ×. *gc* glandular cells, *sd* salivary duct.



Nierstrasz del. Chromolith. P. W. M. Trap Leiden.

PLATE IV.

Colours: see Plate I.

Fig. 113. Dinomenia Hubrechti. Glandular tissue around the salivary glands. 40 ×.

Figs. 114—117. Rhopalomenia debilis.

Fig. 114. Rhopalomenia debilis, drawn from the spirit-specimen. 4 ×.
Figs. 115, 116. Schematic transverse sections through the anterior extremity; fig. 116 more proximally. 40 ×. *a* salivary duct, *b* rudimentary radula-sac, *hb* "hintere Bauchdrüse".
Fig. 117. Transverse section through the rudimentary radula-sac. 215 ×.

Figs. 118—140. Hemimenia intermedia.

Violet the penis-gland, orange the carina-pouches.

Fig. 118. Hemimenia intermedia, drawn from a spirit-specimen. 4 ×.
Fig. 119. The same specimen from the dorsal side. 4 ×.
Fig. 120. Spicula 215 ×. *a*, *f* flat spicula of the body-wall and the carina, *b* lance-point-shaped spicula of the carina-pouches, *c*, *d*, *e* pointed spicula along the ventral groove of the body-wall.
Fig. 121. Hypodermal cells and cuticle of the body-wall. 316 ×.
Fig. 122. The same of the carina-pouches. 316 ×.
Fig. 123. Longitudinal median section through the anterior extremity out of transverse sections. 18 ×. See text.
Figs. 124—130. Transverse sections along the lines *AB*—*NO* of fig. 123 *vb* "vordere Bauchdrüse", *hb* "hintereBauchdrüse", *cr* cirrhi, *m* mouth-opening, *ml* "Mundleisten", *cl* cilia. 18 ×.
Figs. 131—143. Transverse sections through the posterior extremity. 18 ×.
f (figs. 130—133) represents the course of the blood, *o* opening of the precloacal organ *po* into the cloaca, *rs* receptaculum seminis. See text.

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PLATE V.

Colours: see Plate I and Plate IV.

Figs. 141—145. Hemimenia intermedia.

Figs. 141—143. See Plate IV.
Fig. 144. Transverse sections through the gland of the penis-spicula. *A* the vesicles *g* and *h* have not yet united, *B* the two vesicles are united. 125 ×.
Fig. 145. Transverse sections through a penis-spiculum with its epithelial sheath. 125 ×. *A* distal, *C* proximal part.

Figs. 146—171. Cyclomenia holosericea.

Fig. 146. The animal, drawn from the spirit-specimen. 4 ×.
Fig. 147. Spicula. *A* of the body-wall, *B* along the ventral groove. 88 ×.
Fig. 148. Section through the integument. 125 ×.
Fig. 149. Transverse section through the ventral furrow, cf. fig. 164. 50 ×.
Fig. 150. Reconstruction of the anterior extremity out of transverse sections. The red line indicates the contour of the radula. 20 ×. *f* fold of the dorsal wall of the mouth-cavity.
Figs. 151—157 Schematic transverse sections along the lines *AB*—*NO* of fig. 150. 20 ×. *f* fold of the dorsal wall of the mouth-cavity, *s g* salivary gland, *p*, *b* and *a* see text, *r m* radula-muscles. 20 ×.
Fig. 158. Transverse section through the radula-sac. Radula-plates red. 88 ×.
Fig. 159. Transverse section through the radula in the pharynx. 50 ×.
Fig. 160. A part of the radula-muscles. 70 ×.
Figs. 161—171. Schematic transverse sections through the posterior extremity. 20 ×. See text. *a* atrium, *p o* precloacal organ, *f* cloaca-fold, *v* ventricle, *c. s p* cloaca-spicula.

Figs. 172—179. Dondersia annulata.

Fig. 172. The animal, drawn from the spirit-specimen. 4 ×.
Fig. 173. Spicula. 316 ×. *A* and *B* of the body-wall, *C* along the ventral groove.
Figs. 174—176. Schematic transverse sections through the anterior extremity. 40 ×. *m c* mouth-cavity, *r s* radula-sac, *p g* pharyngeal glands, *s g* salivary glands.
Fig. 177. Transverse section through the radula. 50 ×. *a* tooth, *b* base of the next tooth.
Figs. 178—179. Lateral and median longitudinal section through the posterior extremity. *d s* dorso-terminal sense-knots.

Nierstrasz del.

Chromolith. P. W. M. Trap Leiden.

PLATE VI.

Colours: see Plate I.

Figs. 180—203. Chaetoderma Lovéni.

Figs. 180, 181. Chaetoderma Lovéni, drawn from spirit-specimens. 4 ×.
Fig. 182. Posterior extremity with the long straight spicula. 37 ×.
Fig. 183. Spicula 75 ×. *A* of the body-wall, *B* around the mouth-opening, *C* of the posterior extremity.
Fig. 184. Section through the integument. 125 ×. *R* "Riesenzellen".
Fig. 185. Section through the integument of the middle region. 215 ×.
Figs. 186—190. Schematic transverse sections through the anterior extremity. *c* "Mundschild", *a* see text, *m* lateral, *m'* dorsal, *m''* ventral retractors. 30 ×.
Figs. 191—192. Sections through the radula of one of the specimens. 215 ×. See text.
Figs. 193—194. Sections through the radula of the other specimen. 215 ×. See text.
Fig. 195. Schematic transverse section through the middle region of the animal. 30 ×. *l* liver, *i* intestine.
Figs. 196—200. Schematic transverse sections through the posterior extremity. 39 ×. *g* gills, *g m* gill-protractor, *v r* ventral retractors, *d r* dorsal retractors, *l r* lateral retractors, *g p s* ganglion posterius superius.
Fig. 201. Section through the pericardium, in which the ganglion posterius superius *G.p.s.* *a* atrium, *d r* dorsal retractors. 75 ×.
Figs. 202, 203. Sections through the cerebral ganglion *h g*, *3*, *4*, *5*, *6* lateral ganglia, *1*, *2* proximal ganglia. 50 ×.

Figs. 204—210. Chaetoderma Wiréni.

Fig. 204. Chaetoderma Wiréni, drawn from the spirit-specimen. 4 ×.
Fig. 205. Spicula. 75 *A* of the body-wall, *B* of the posterior extremity, *C* around the mouth-opening.
Figs. 206, 207. Schematic transverse sections through the anterior part 29 ×. *m'* dorsal retractors, *m* lateral retractors, *m''* ventral retractors.
Fig. 208. Section through the integument. 125 ×.
Figs. 209, 210. Sections through the radula. 215 ×. See text.

Figs. 211—216.

Fig. 211. Radula of Chaetoderma canadense. 215 ×. See text.
Figs. 212, 213. Radula of Chaetoderma sp. (NORMAN). 388 ×. See text. *t c* tongue-cartilage, *m* muscle, *s g* sublingual ganglion, *E* ciliated epithelium of the pharynx.
Figs. 214, 215. Radula of Chaetoderma sp. (= Chaetoderma Lovéni). 215 ×. See text.
Fig. 216. Radula of Chaetoderma nitidulum. 215 ×. See text.

SIBOGA-EXPEDITIE

Siboga-Expeditie

UITKOMSTEN

OP

ZOOLOGISCH, BOTANISCH, OCEANOGRAPHISCH EN GEOLOGISCH GEBIED

VERZAMELD IN

NEDERLANDSCH OOST-INDIË 1899—1900

AAN BOORD **H. M. SIBOGA** ONDER COMMANDO VAN

Luitenant ter zee 1e kl. G. F. TYDEMAN

UITGEGEVEN DOOR

Dr. MAX WEBER † en **Prof. Dr. L. F. DE BEAUFORT**

Prof. in Amsterdam, Leider der Expeditie — Directeur van het Zoölogisch Museum Amsterdam

(met medewerking van de Maatschappij ter bevordering van het Natuurkundig Onderzoek der Nederlandsche Koloniën)

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SOLENOGASTREN DER SIBOGA-EXPEDITION

VON

H. A. STORK
Utrecht

Mit 2 Tafeln und 41 figuren im Text

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SOLENOGASTREN DER SIBOGA-EXPEDITION

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H. A. STORK

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A. EINLEITUNG

In der Sammlung der Siboga-Expedition befanden sich noch einige Solenogastren, welche bis jetzt unbearbeitet geblieben waren. Herr Professor Dr. DE BEAUFORT war so freundlich mir das Studium dieser Tierchen zu überlassen, wofür ich ihm an dieser Stelle meinen herzlichsten Dank ausspreche.

Von einem Tiere (*Crystallophrisson sibogae* nov. spec.) und vom Hinterende eines zweiten (*Dondersia indica* nov. spec.) waren schon Querschnitte (10 μ) vorhanden, vom letzteren allerdings auch einige Frontalschnitte, weil es gekrümmt war. Das Hinterende dieses Exemplars wurde mit Boraxkarmin gefärbt, während das Vorderende des zuerstgenannten Tieres mit Cochenille und sein Hinterende mit Karmalaun gefärbt worden war. Das Vorderende der *Dondersia* nov. spec., sowie die übrigen Tiere, habe ich mit Karmalaun (nach DE GROOT) in toto gefärbt und in Querschnitte (10 μ) zerlegt. Soweit die Tiere nicht entkalkt waren, wurden die Spicula mit Eau de Javelle isoliert.

Die Tiere lagen schon seit etwa 40 Jahren in Alkohol; die Konservierung ist denn auch oft mangelhaft und eine eingehende histologische Bearbeitung muss unterbleiben. Auch die Zeichnungen sind daher schematisiert. Herrn J. PRIJS bin ich für die Anfertigung der Abbildungen der Tiere, welche auf den Tafeln dargestellt sind, sehr verpflichtet.

B. DESKRIPTIVER TEIL

Crystallophrisson MÖBIUS [1])

1. *Crystallophrisson sibogae* nov. spec.

Stat. 208. 1 Exemplar.

Diagnose: Länge 65 mm, Längenindex 26; Mundschild rundlich, enthält die Mundöffnung; 4 Muskelfelder, welche sich zugleich in kleine Bündel aufspalten; etwa 3 Paare dorsaler Retraktoren, einige laterale Retraktoren; bukkale Drüsen, dorsale und laterale Vorderdarmdrüsen vorhanden; Radula besteht aus 2 Zähnen.

1) Mit Recht bemerkt THIELE (9), dass der Name *Chaetoderma* schon vergeben ist durch SWAINSON 1839 (8, S. 194) für eine Untergattung der Fischgattung *Monacanthus*.

Das Tier war schon in Schnitten zerlegt worden. In Fig. 1 der Tafel I ist es daher nach einer Rekonstruktion 5 fach vergrössert abgebildet. Die Länge beträgt 65 mm, der Querdurchmesser im vordern Teil 2 mm, im hintern Teil 3 mm (in Alkohol). Der Längenindex ist 26. Das wurmförmige Tier ist in seinem mittleren Teil dünn und kaudal ist es zugespitzt. In Alkohol ist die Farbe gelbgrau. Die schlitzförmige Mundöffnung liegt terminal und wird von dem Mundschilde ganz umgeben; jedoch ist das vordere terminale Ende des Tieres etwas dorsal gebogen, sodass der Mundschild und die Mundöffnung auch einigermassen dorsad verschoben sind. Auch die Analraumöffnung liegt terminal. Die Ursprungsstelle der Retraktoren des Vorderendes wird von einer ringförmigen Furche angedeutet.

Das Integument ist stark beschädigt, sodass seine Beschreibung unterbleiben muss. Soweit sich beurteilen lässt haben Epidermis und Kutikula normalen Bau und sind auch Riesenzellen vorhanden. Vor dem Schneiden war das Tier wahrscheinlich entkalkt worden; von Spicula ist wenigstens nichts mehr zu sehen.

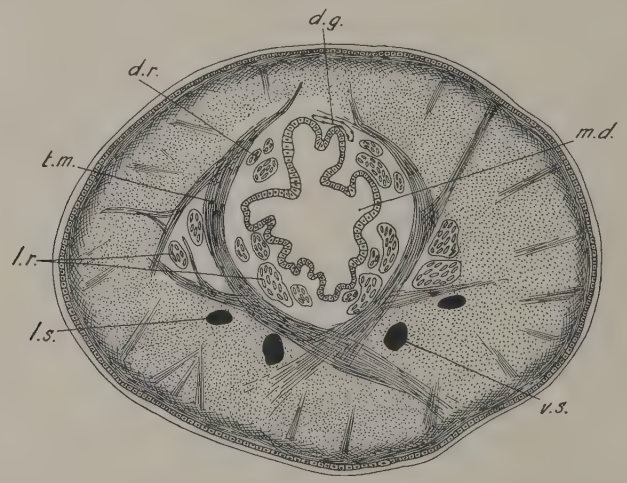

Fig. 1. 33 ×

Das dorso-terminale Sinnesorgan ist, wie gewöhnlich, länglich grubenförmig; es liegt dorsal vom Analraum. Sein Epithel enthält prismatische und schlanke Zellen mit spindelförmigen Kernen, welche letztere Sinneszellen sein mögen.

Der Analraum hat ein kubisches bis zylindrisches Flimmerepithel. Seine Zellen enthalten runde Kerne und werden von einer dünnen Kutikula bedeckt. Lateral von der Analöffnung, sowie lateral von den Kiemen öffnen sich die Schalendrüsen, derer Epithel sich auf den ventro-lateralen Wänden des Analraumes fortsetzt.

Die Kiemen sind im Analraum eingezogen und zeigen keine Besonderheiten.

Die Muskulatur ist kräftig ausgebildet. Die Ringmuskelschicht (Fig. 3, *r.m.*) ist im kaudalen Teil des Vorderendes dünn, während die Längsmuskeln in diesem Teil einen Zylinder bilden, der sich in vier dünne Felder spaltet (Fig. 3, *l.m.*). Wie bei *Cr. lovéni, Cr. wiréni,* u.s.w. teilen sich diese vier Felder zugleich in zahlreiche Muskelbündel auf (Fig. 2, *l.m.*). An dieser Stelle nimmt die Ringmuskelschicht beträchtlich an Dicke zu und treten die Diagonalmuskeln auf (Fig. 2, *r.m.* und *d.m.*). Der Hautmuskelschlauch und besonders die Längsmuskelbündel sind sehr kräftig ausgebildet, sodass

die Muskeln den Raum zwischen Haut und Vorderdarm fast ganz ausfüllen. Durch Punktierung ist dies in Figur 1 schematisch angedeutet.

Im kaudalen Teil des Tieres ist die Hautmuskelschicht bei der Mitteldarmdrüse dünn. Etwas weiter kaudal wird sie bedeutend dicker, besonders was die Diagonalmuskeln betrifft. Eine Spaltung der Längsmuskeln in vier Felder findet im kaudalen Teil nicht statt. Die Analraumöffnung wird von einem starken Sphinkter umgeben.

Die Retraktoren des Vorderendes sind zahlreich und ebenfalls kräftig ausgebildet. Es sind ein Paar grösserer und etwa zwei Paare kleinerer dorsale Retraktoren (Fig. 1, *d.r.*) vorhanden, welche den dorso-lateralen und lateralen Seiten des Mitteldarmes entlang kraniad ziehen und sich an der lateralen Körperwand anheften. Einige laterale Retraktoren (Fig. 1, *l.r.*) spalten sich an den

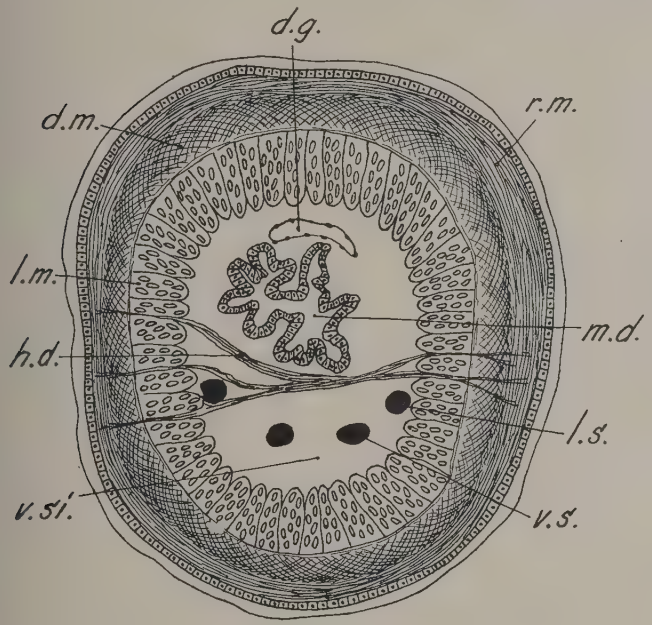

Fig. 2. 50 ×

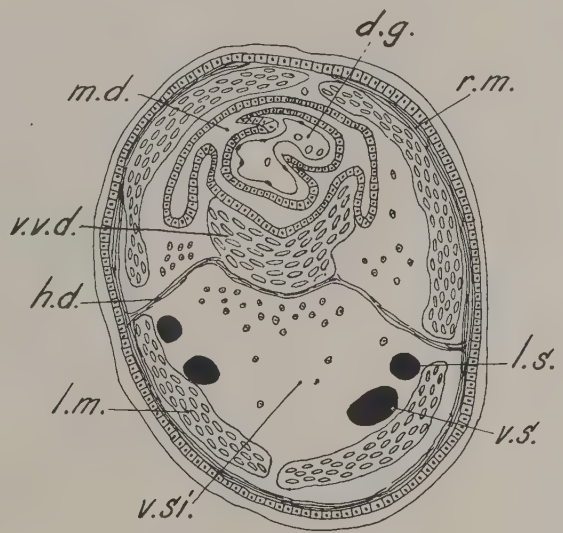

Fig. 3. 50 ×

lateralen und ventro-lateralen Seiten von den Längsmuskelbündel ab. Sie ziehen ebenso kranio-ventrad und inserieren an der ventro-lateralen Körperwand. Weiter habe ich ein Paar ventraler Retraktoren auffinden können, welche zusammen mit einigen Radulamuskeln aus den Längsmuskelbündeln, ventral vom horizontalen Diaphragma, entspringen.

Von Kiemenretraktoren gibt es ein Paar kräftiger, vordere dorsale Retraktoren (Fig. 5, *v.d.r.*), sowie zwei Paare kleinere hintere dorsale Retraktoren (Fig. 5, *h.d.r.*). Wie gewöhnlich werden diese drei Paare vom Perikard umschlossen. Weiter sind vorhanden: ein Paar latero-ventraler Retraktoren (Fig. 5, *l.v.r.*) und ein Paar vordere ventrale Retraktoren (Fig. 5, *v.v.r.*). Auch das hintere ventrale Kiemenretraktorenpaar (Fig. 5, *h.v.r.*) ist vorhanden.

Das horizontale Diaphragma (Fig. 2,*h.d.*) ist kräftig ausgebildet. Ausserdem ist da, wo die vier Längsmuskelfelder anfangen sich in Muskelbündel aufzuteilen, ein vorderes vertikales Diaphragma (Fig. 3, *v.v.d.*) vorhanden, welches zwischen Mitteldarm, Körperwand und horizontales Diaphragma ausgespannt ist. Bis jetzt ist es noch von keiner einzigen *Crystallophrisson* Art bekannt geworden. Wohl aber beschreibt HEATH ein dergleiches Gebilde für *Limifossor* (1, S. 70), wovon er

behauptet, dass es bindegewebiger Natur sei. Bei meinem Tier besteht aber keinen Unterschied mit dem horizontalen Diaphragma, wovon es vielmehr eine Fortsetzung bildet. Ich halte es denn auch für muskulös. Zwischen Perikard, Gonade, Schalendrüsen und Mitteldarmdrüse ist ein hinteres vertikales Diaphragma vorhanden.

Die sich kreuzenden Transversalmuskeln (Fig. 1, *t.m.*), im kranialen Teil, schliessen den Mitteldarm ventral und lateral ein.

Das Zerebralganglion lässt auch hier eine Zusammensetzung aus zwei Teilen erkennen.

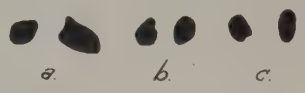

Fig. 4. 333 ×

Seinen kranialen, lateralen und dorsalen Seiten liegen sechs kräftig ausgebildete Praezerebralganglien an, wie bei *Cr. nitidulum,* während sie bei *Cr. lovéni, Cr. wiréni, Cr. hoffmanni,* u.a. klein sind.

Bei der zuletztgenannten Form beschrieb ich (7, S. 110) irrtümlich vier Paare Praezerebralganglien. Die beiden am meisten medial gelegenen Ganglienzellenhäufchen, welche ich damals für Ganglien hielt, entbehren aber der Konnektive, sodass sie den Zerebralganglien zugehören und *Cr. hoffmanni* somit auch sechs kleine Praezerebralganglien besitzt.

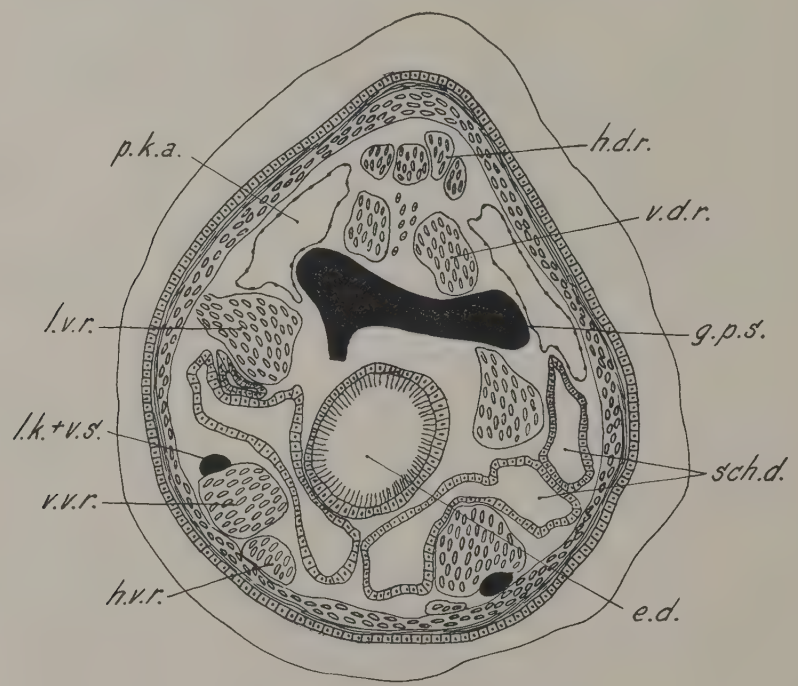

Fig. 5. 50 ×

Vom kranialen Ende des Zerebralganglions entspringen die Zerebro-lateral-, Zerebro-ventral- und Zerebro-bukkalkonnektive jederseits mit einer gemeinsamen Wurzel. Davon trennt sich zuerst das Bukkalkonnektiv ab und etwas weiter kaudal spaltet sich die genannte Wurzel in das Zerebro-lateral und das Zerebro-ventralkonnektiv. Die Ventral- und Bukkalganglien sind gut ausgebildet;

Lateralganglien fehlen. Eine Kommissur vereinigt die beiden Bukkalganglien ventral vom Vorderdarm und kaudal vom Radulaapparat. Das Ganglion posterius superius (Fig. 5, *g.p.s.*) wird vom Perikard umgeben.

Ob eine Innervierung der kranialen Wand der Mundöffnung stattfindet, wie bei *Cr. nitidulum* und *Cr. canadense,* ist aus den Schnitten nicht mehr zu ersehen.

Die Mundöffnung liegt im Mundschilde. Die Wände des Vorderdarmes sind zuerst kräftig gefaltet. Beim Radulaapparat erweitert sich der Vorderdarm beträchtlich und bildet zwei grosse laterale Falten, welche sich kaudal vom Radulaapparat mit einander vereinigen. Hierdurch wird ein dorsales und kaudal verlaufendes Coecum gebildet. Kaudal vom Radulaapparat wird der Vorderdarm enger und mündet alsbald in den Mitteldarm ein. Sein Epithel besteht aus hohen prismatischen Flim-

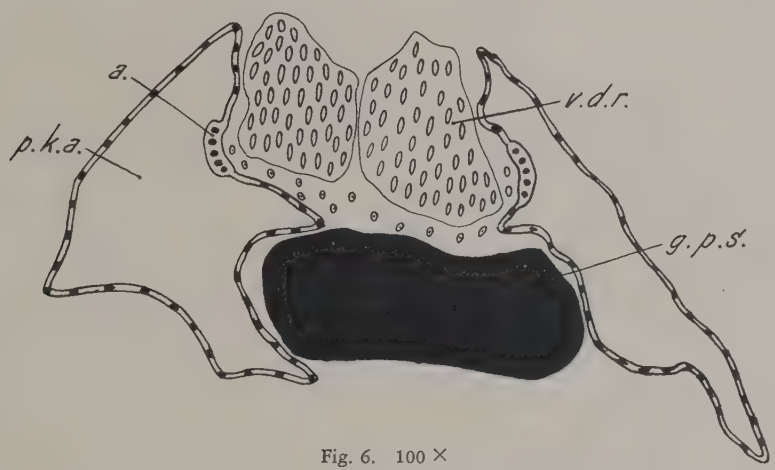

Fig. 6. 100 ×

merzellen mit ovalen und runden Kernen; es wird von einer dünnen Kutikula bedeckt. Eine Ringmuskelschicht umgibt den Vorderdarm.

Der Radulaapparat ist aus den normalen Komponenten zusammengesetzt. Der Träger ist kutikular. Der kaudale Teil des Apparates liegt frei im Vorderdarmlumen und trägt auf seinem distalen Ende zwei Zähne, welche etwa kaudal gerichtet waren und beim Schneiden einigermassen quer geschnitten sind. In den Präparaten sind sie in drei Schnitten vorhanden, welche in Figur 4 abgebildet sind.

In das soeben erwähnte dorsale Vorderdarmcoecum münden die dorsalen Vorderdarmdrüsen, während die lateralen Vorderdarmdrüsen ebenfalls, und zwar in den lateralen Falten, vorhanden sind. Auch bukkale Drüsen münden, kaudal und lateral von der Mundöffnung, in den Vorderdarm.

Ein dorsales Mitteldarmcoecum fehlt. Der Mitteldarm (Fig. 2, *m.d.*) ist in seinem kranialen Teil eng mit gefalteten Wänden, welche aus zylindrischen und kubischen Zellen bestehen. Diese haben grosse Kerne und werden fast ganz von grünen Körnchen ausgefüllt.

Die Struktur der Mitteldarmdrüse hat sich nicht gut erhalten; doch glaube ich, dass der Bau keine Besonderheiten aufweist. Der Enddarm (Fig. 5, *e.d.*) bildet einige Windungen.

Das vorliegende Exemplar ist ein Weibchen; das Ovarium enthält reife Eier. Gonade, gonoperikardiale Gänge, sowie Perikard haben normalen Bau. Letzteres spaltet sich auch hier in zwei Ausläufer (Fig. 6, *p.k.a.*), welche die dorsalen Kiemenretraktoren und das Ganglion posterius superius umschliessen und sich weiter kaudal wieder miteinander vereinigen.

Von diesem kaudalen unpaaren Teil des Perikards gehen die Gonodukte ab, welche sich in die getrennt mündenden Schalendrüsen (Fig. 5, *sch. d.*) fortsetzen. Die Struktur dieser Ausführungsgänge ist normal. Wie gesagt setzen sich die Epithelien der Schalendrüsen auf der Analraumwand fort.

Das Herz ist ausgezeichnet konserviert erhalten geblieben. Das Atrium (Fig. 6, *a*) hat einen paarigen Ursprung an den medianen Wänden der beiden perikardialen Ausläufer. Beide Falten vereinigen sich alsbald und das unpaare Atrium liegt mit seinem kranialen Endteil frei im Perikard. In Figur 7 ist das Atrium abgebildet. Man sieht, dass es keinen gleichmässigen Bau zeigt. In der rechten Hälfte der Figur ist es voluminöser als in der Linken und es enthält rechts auch mehr Blutelemente als links. Ebenso ist das Epithel im erstgenannten Teil viel mehr abgeflacht und auch setzt sich

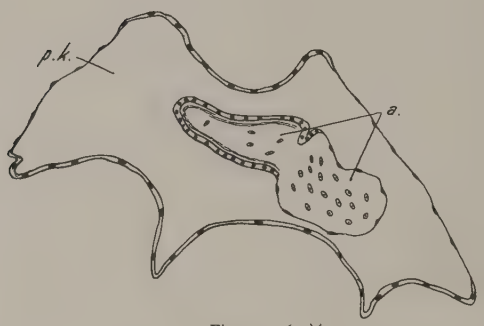

Fig. 7. 67 ×

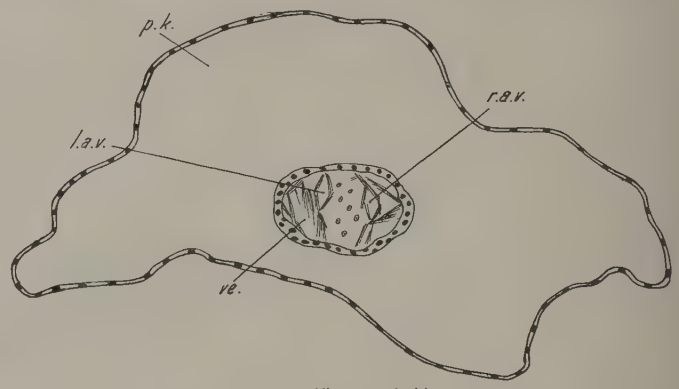

Fig. 8. 67 ×

dieser Teil entlang dem Ventrikel fort, während der andere Teil sich in den Ventrikel öffnet. Hier sind wohl Kontraktionserscheinungen im Spiel. Nur wenige Muskelfibrillen sind im Atrium vorhanden.

Die beiden atrio-ventrikularen Öffnungen (Fig. 8, *l.a.v., r.a.v.*) sind deutlich zu beobachten.

Der Ventrikel liegt mit seinem kaudalen Teil frei im Perikard; weiter kranial vereinigt er sich mit der dorsalen Perikardwand (Fig. 9, *ve.*), aber niemals ist er eine Einstülpung von dieser. Seine Wand ist dicker als vom Atrium und auch seine Muskulatur ist viel kräftiger ausgebildet.

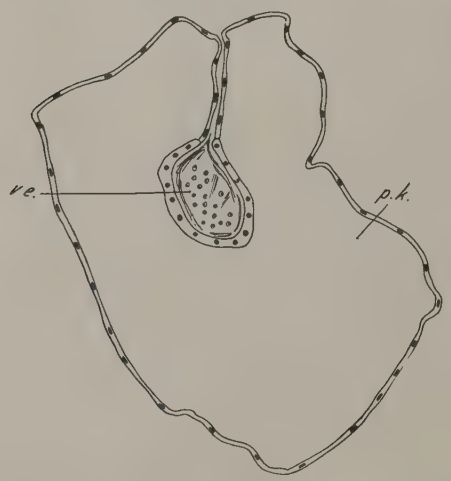

Fig. 9. 67 ×

Kranial setzt sich der Ventrikel in das Dorsalgefäss fort (Fig. 3, *d.g.*), während die beiden Atrialanlagen ihr Blut aus dem Hohlraum zwischen den perikardialen Ausläufern erhalten, welcher wieder mit den dorsalen Kiemensinus zusammenhängt.

Das vorliegende Tier ist deutlich verschieden von Arten wie *Cr. nitidulum, Cr. productum, Cr. gutturosum, Cr. hoffmanni,* und von den von NIERSTRASZ beschriebenen *Crystallophrisson*-Arten. HEATH (1 & 2) beschreibt nicht weniger als 15 *Crystallophrisson*-Arten, jedoch berücksichtigt er in seiner wertvollen Arbeit das Muskelsystem und die eigentliche Radula nicht, gerade Organe, welche systematisch von

grösster Bedeutung sind bei den Crystallophrissontidae. Ich habe mich somit bei der Vergleichung mit HEATH' Arten auf die äussere Körperform und die übrigen mehr gleichförmigen Organe zu beschränken. Bei meinem Tier fehlen leider die Spicula. Jedoch glaube ich, dass die Unterschiede genügen, die Aufstellung des jetzt beschriebenen Tieres, sowie auch der weiter unten zu beschreiben *Crystallophrisson*-Arten, als neue Arten zu rechtfertigen.

Hätte HEATH auch die soeben erwähnten Organsysteme berücksichtigt, so wären vielleicht auch die Unterschiede zwischen z.B. *Cr. attenuatum* und *Cr. montereyense* deutlicher geworden. Jetzt sind die Unterschiede wohl geringfügig und kann man Zweifel daran hegen ob hier wohl verschiedene Arten vorhanden sind.

2. *Crystallophrisson indicum* nov. spec.

Stat. 52. 1 Exemplar.

Diagnose: Länge 40 mm; Längenindex 21; Mundschild herzförmig, enthält die Mundöffnung; 4 Muskelfelder, welche sich zugleich in kleine Bündel aufspalten; ein Paar dorsaler Retraktoren, einige laterale und einige ventrale Retraktoren; 5 Paare Kiemenretraktoren; dorsales Vorderdarmcoecum kranial gerichtet; bukkale Drüsen, dorsale und laterale Vorderdarmdrüsen vorhanden; Radula aus 2 Zähnen bestehend; Spicula am zugespitzten Hinterende mit braunem Knopf.

Figur 2 der Tafel I stellt das Tier 10 fach vergrössert dar. Seine Länge ist 40 mm; der Diameter am Vorderende 7/4 mm, am Hinterende 2 mm; Längenindex 21. Das kraniale Ende ist scheibenförmig mit einem Mundschilde, wie es in Figur 10 abgebildet ist. Der Mundschild enthält die Mundöffnung als Längsspalte. Der lange mittlere Teil des Tieres ist schmal, der kaudale Teil wiederum dick mit einem zugespitzten terminalen Ende, welches von langen Spicula, mit einem braunen rostfarbigen Knopf an ihrem distalen Ende, bedeckt wird. Gerade vor dem zugespitzten Ende sind auf dem verbreiterten Rande mehrere lange Spicula eingepflanzt. Die Ursprungsstelle der Retraktoren des Vorderendes wird auch hier von einer transversalen Furche angedeutet. Die Analraumöffnung liegt terminal und wird lateral von zwei Fortsetzungen der Körperwand begleitet. Die Kiemen sind eingezogen.

Fig. 10. 10 × Kraniales Ende von Vorne gesehen

Das Integument ist mangelhaft konserviert. Riesenzellen sind jedenfalls vorhanden. Sehr eigentümlich sind die Spicula, die auf dem zugespitzten kaudalen Teil eingepflanzt sind (Fig. 11 *c.*). Das zugespitzte distale Ende dieser langen Spicula wird nämlich von einem länglichen, rostfarbigen Knopf umgeben. Gleich kranial von diesen Spicula liegen lange Spicula (Fig. 11 *b*) auf dem verbreiterten Rande, während das Vorderende von kleinen Spicula (Fig. 11 *a*) bedeckt wird.

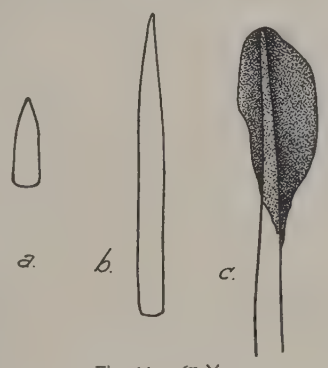

Fig. 11. 67 ×

Das dorso-terminale Sinnesorgan fängt etwas kranial vom Analraum an und hört gleich vor der Analraumöffnung auf.

Im kaudalen Teil des Vorderendes ist die Ring- und Längsmuskulatur dünn und die Längsmuskeln spalten sich alsbald in 4 kurze und dicke Felder, welche sich zugleich in Längsmuskelbündel aufteilen. An dieser Stelle wird die Ringmuskelschicht viel dicker und die Diagonalmuskeln treten deutlich auf (Fig. 15, *r.m.* und *d.m.*). Im kaudalen Teil fehlen auch hier die 4 Felder.

Von den Retraktoren des Vorderendes ist nur ein Paar dorsaler Retraktoren (Fig. 13, *d.r.*) vorhanden, während einige laterale (Fig. 13, *l.r.*) und ebenso einige ventrale Retraktoren (Fig. 13, *v.r.*) zu beobachten sind.

Von den Kiemenretraktoren sind ein Paar vordere dorsale (Fig. 16, *v.d.r.*) und zwei Paare hintere dorsale Retraktoren (Fig. 16, *h.d.r.*) vorhanden. Auch ein Paar latero-ventrale (Fig. 16, *l.v.r.*) und ein Paar vordere ventrale Retraktoren (Fig. 16, *v.v.r.*) habe ich auffinden können. Die hinteren ventralen Retraktoren fehlen aber.

Die transversalen Muskeln des Vorderendes, sowie das horizontale und die beiden vertikalen

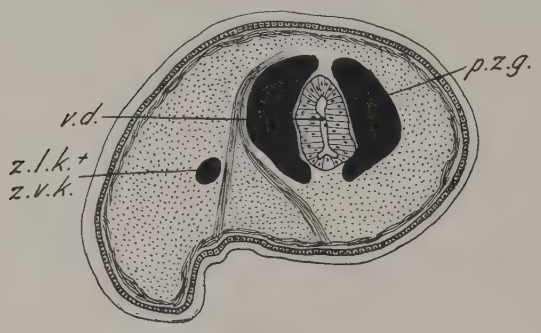

Fig. 12. 50 ×

Fig. 14. 500 ×

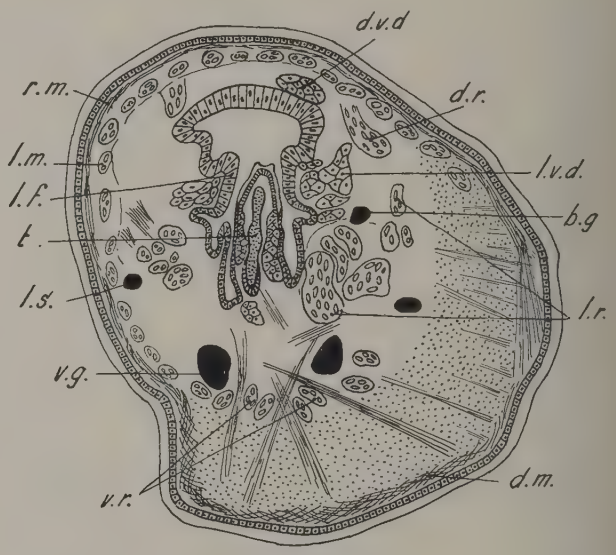

Fig. 13. 50 ×

Diaphragma sind vorhanden. Die Muskulatur füllt jedoch das Tier bei weitem nicht so aus, wie es beim vorigen Tiere der Fall war.

Das Zerebralganglion liegt dorsal und dorso-lateral vom Vorderdarm. Wie beim vorigen Tiere sind die Praezerebralganglien gross, aber ihre Lage ist typisch. Sie umgeben den Vorderdarm fast ganz und lassen nur einen sehr kleinen Teil der ventralen Seite frei (Fig. 12, *p.z.g.*). Das übrige Nervensystem stimmt mit dem des soeben beschriebenen Tieres überein.

Die kraniale Wand der Mundöffnung ist beschädigt, sodass nicht zu entscheiden ist, ob diese Wand wie bei *Cr. nitidulum,* u.a. innerviert wird.

Zwischen den Praezerebralganglien hat der Vorderdarm ein spaltförmiges Lumen (Fig. 12, *v.d.*). Er wird von einer Ringmuskelschicht umgeben. In der Nähe des Radulaapparates erweitert sich der Vorderdarm beträchtlich und bildet auch zwei laterale Falten (Fig. 13, *l.f.*), welche aber kaudal vom Radulaapparat verschwinden ohne sich mit einander zu vereinigen. Gleich vor dem Radulaapparat bildet der Vorderdarm an seiner dorsalen Seite ein kranial (und nicht wie beim vorigen Tiere kaudal) gerichtetes Coecum. In dieses Coecum münden die dorsalen Vorderdarmdrüsen (Fig. 13, *d.v.d.*). Die lateralen Vorderdarmdrüsen (Fig. 13, *l.v.d.*) liegen in den grossen lateralen Falten,

während der vordere Teil des Vorderdarmes bis an die Praezerebralganglien ganz von Bukkaldrüsen umgeben wird.

Vom Radulaapparat ist der Träger (Fig. 13, *t.*) kutikular. Es sind zwei gekrümmte Zähne vorhanden; der rechte ist gebrochen und vom linken ist wahrscheinlich nur ein Fragment übrig (Fig. 14).

Auch hier fehlt ein dorsales Mitteldarmcoecum. Der Mitteldarm ist, im Gegensatz zum vorigen Tiere, in seinem kranialen Teil sehr weit, während Falten in diesem Teil fehlen (Fig. 15, *m.d.*). Seine kubischen und zylindrischen Zellen haben runde Kerne und enthalten grüne Körnchen.

Die dorsale Wand der Mitteldarmdrüse besteht aus Körnerzellen, die lateralen und ventralen Wände, sowie die Falten dieser Wände aus Keulenzellen, welche das Lumen der Drüse grossenteils ausfüllen.

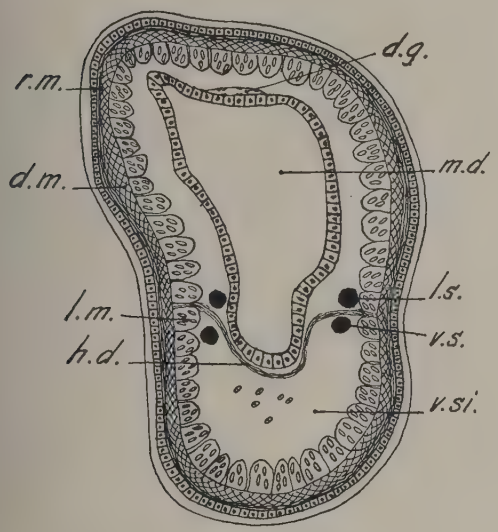

Fig. 15. 50 ×

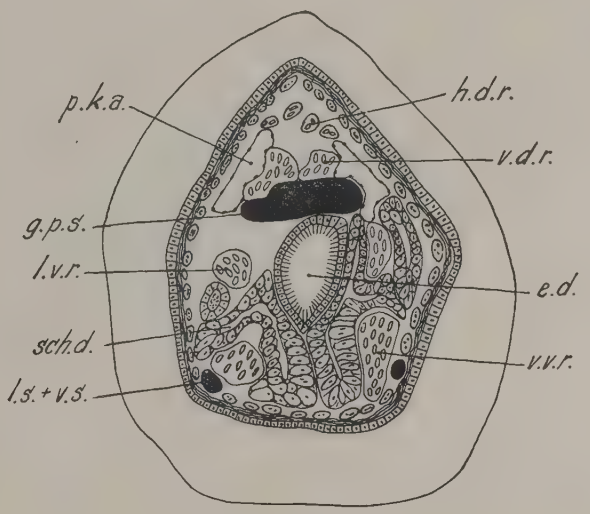

Fig. 16. 50 ×

Der Enddarm bildet einige Windungen.

Das Tier gehört zum männlichen Geschlecht. Gonade, gono-perikardiale Gänge, Gonodukte und Schalendrüsen zeigen nichts erwähnenswertes. Der mangelhaften Konservierung wegen ist nicht zu entscheiden ob die Schalendrüsen sich auf den Analraumwänden fortsetzen.

Auch das Herz hat sehr gelitten, sodass der Bau nicht zu studieren ist.

Das vorliegende Tier ist dem Vorigen nahe verwandt. Im Muskelsystem und im Vorder- und Mitteldarm bestehen aber beträchtliche Unterschiede. Auch die Lage der Praezerebralganglien beim vorliegenden und die Ausfüllung des Körpers mit Muskelgewebe beim vorigen Tiere weisen darauf hin, dass verschiedene Arten vorliegen.

3. *Crystallophrisson orientale* nov. spec.

Stat. 300. 1 Exemplar.

Diagnose: Länge 10 mm; Längenindex 5; Vorderende blasenförmig erweitert; der trapezförmige Mundschild enthält die Mundöffnung; 4 Muskelfelder, welche sich zugleich in zahlreiche

Bündel aufspalten; ein Paar dorsaler, einige laterale und ein Paar (?) ventraler Retraktoren; bukkale Drüsen, dorsale und laterale Vorderdarmdrüsen vorhanden; Radula aus zwei Zähnchen zusammengesetzt; Mitteldarm mit dorso-lateralen und ventro-lateralen Einbuchtungen.

Auf Tafel I ist in Figur 3 das Tier 8 fach vergrössert abgebildet. Figur 4 und Figur 5 der Tafel I zeigen das Vorder- bzw. das Hinterende bei 20 facher Vergrösserung. Das Tier ist 10 mm lang; sein Vorderende ist blasenförmig erweitert und hat einen Diameter von 2 mm. Sodann folgen zwei schmälere Zonen, während der kaudale Teil wiederum breit ist ($2\frac{1}{2}$ mm) mit schmälerem terminalen Endteil. Der Längenindex beträgt $\pm$ 5. Lange Spicula stehen, transversal angeordnet,

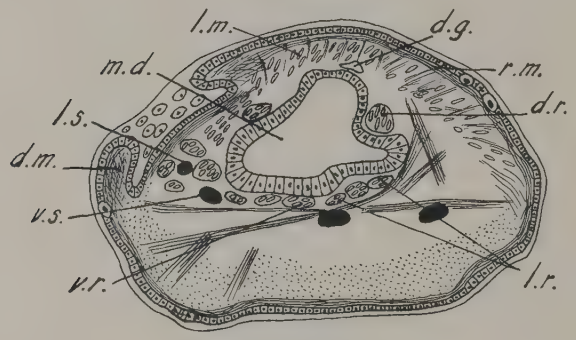

Fig. 17. 50 ×

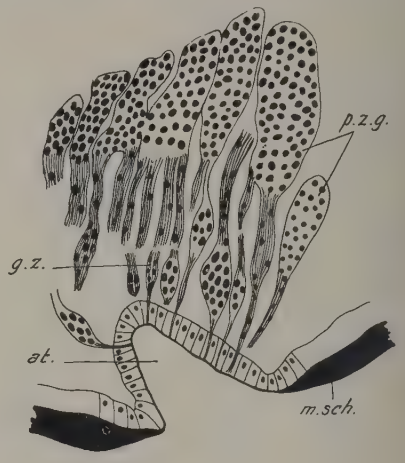

Fig. 18. 200 ×

auf der Grenze vom dicken und schmalen kaudalen Teil. Die Spicula am vordern Körperteil sind klein. Die Farbe ist grau-gelb (in Alkohol). Der Mundschild, welcher trapezförmig ist, umgibt die Mundöffnung.

Die Konservierung ist mangelhaft und das Hinterende war teilweise beschädigt, sodass besonders vom Hinterende keine vollständige Beschreibung gegeben werden kann.

So ist vom Integument fast nichts mehr zu beobachten.

Ein dorso-terminales Sinnesorgan ist dorsal vom Analraum vorhanden.

Die 4 Muskelfelder (Fig. 20, *l.m.*) sind kräftig ausgebildet und spalten sich zugleich in mehrere kleine Muskelbündel auf. Die Ring- (Fig. 17, *r.m.*) und Diagonalmuskeln (Fig. 17, *d.m.*) sind an dieser Stelle auch dicker und ein vorderes vertikales Diaphragma ist vorhanden.

Ein Paar dorsaler Retraktoren (Fig. 17, *d.r.*), welche in Einbuchtungen des Mitteldarmes ventro-kraniad ziehen, heften sich an der ventro-lateralen Körperwand an. Einige laterale Retraktoren (Fig. 17, *l.r.*) liegen eng aneinander geschlossen ebenso in Einbuchtungen des Mitteldarmes. Wahrscheinlich ist nur ein Paar ventraler Retraktoren (Fig. 17, *v.r.*) vorhanden, jedoch lässt die Konservierung kein sicheres Urteil zu.

Von der Muskulatur des Hinterendes sind die Kiemenretraktoren gut erhalten. Ein Paar vordere dorsale und zwei Paare hintere dorsale Retraktoren (Fig. 21, *h.d.r.*), ein Paar latero-ventrale (Fig. 21, *l.v.r.*), sowie ein Paar vordere ventrale Kiemenretraktoren sind vorhanden. Hintere ventrale Kiemenretraktoren fehlen.

Vom Nervensystem ist nur zu erwähnen, dass das Ganglion posterius superius zwischen den beiden perikardialen Ausläufern liegt und dass sein Vorderende vom vorderen unpaaren Perikardteil umfasst wird.

Die Innervierung der kranialen Wand der Mundöffnung ist beim vorliegenden Tier recht deutlich zu beobachten. In Figur 18 sind die Verhältnisse abgebildet. Schon früher (6, S. 80) habe ich darauf hingewiesen, dass ich mit THIELE diesen Teil dem Atrium der übrigen Solenogastren homolog setze und ein Vergleich mit dem Atrium letzterer lehrt, dass sich das Organ bei den Crystallophrissontidae in Regression befindet. Der Mundschild, welcher sich im Zusammenhang mit der grabenden Lebensweise ausgebildet hat, mag die Funktion der Atrialleisten und Cirren grossenteils übernommen haben. Auch die Radula ist bei den Crystallophrissontidae in Regression begriffen,

Fig. 19. 333 ×

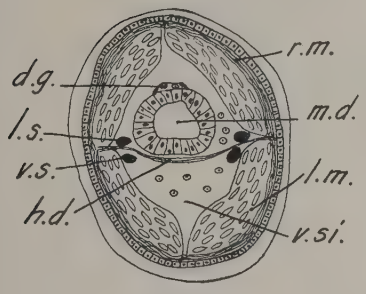

Fig. 20. 50 ×

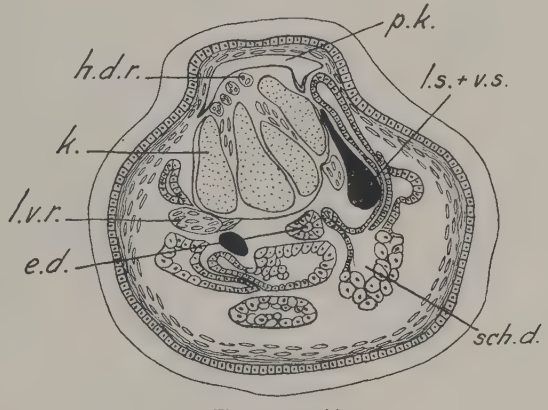

Fig. 21. 50 ×

während Bauchfurche, Bauchfalte und Bauchdrüsen ganz verschwunden sind, was ebenso mit der grabenden Lebensweise zusammenhängen mag.

Die Konservierung des Vorderdarmes ist schlecht. Um den Vorderdarm herum liegen zahlreiche bukkale Drüsen, während auch die dorsalen und lateralen Vorderdarmdrüsen vorhanden sind. Das dorsale Vorderdarmcoecum ist, wie gewöhnlich, kaudal gerichtet.

Der Träger des Radulaapparates ist kutikular. Der kaudale, frei in den Vorderdarm hineinragenden Teil dieses Apparates trägt zwei Zähnchen, welche beide in 3 Stücke gebrochen sind (Fig. 19).

Der Mitteldarm (Fig. 17, *m.d.*) ist, soweit er in den Präparaten vorhanden ist, gerade. An seinen dorso-lateralen und ventro-lateralen Seiten ist er eingebuchtet und, wie gesagt, verlaufen in den Einbuchtungen die Retraktoren des Vorderendes.

Die Mitteldarmdrüse und der Enddarm (Fig. 21, *e.d.*) haben normalen Bau.

Die Gonaden fehlen in den Schnitten und da auch Perikard und Analraumgänge keine Geschlechtsprodukte enthalten ist nicht zu sagen ob ein Männchen oder ein Weibchen vorliegt und ob das Tier geschlechtsreif ist.

Die Schalendrüsen setzen sich auf den Analraumwänden fort.

Der vordere Teil des Ventrikels fehlt in den Schnitten; der übrige Teil des Herzens zeigt keine Besonderheiten. Es ist mir aber nicht gelungen die atrio-ventrikularen Öffnungen auf zu finden.

4. *Crystallophrisson odhneri* nov. spec.

Stat. 52. 1 Exemplar.

Diagnose: Vorderende blasenförmig erweitert; der rundliche Mundschild enthält die Mundöffnung; die dorsalen Muskelfelder teilen sich kranial zuerst in 3 Muskelbündel, die ventralen Felder verschwinden zeitlich; einige dorsale, einige laterale und ein Paar ventraler Retraktoren; bukkale Drüsen, dorsale und laterale Vorderdarmdrüsen vorhanden; Radula aus 2 Zähnchen zusammengesetzt. Mitteldarm dorso-lateral und ventro-lateral eingebuchtet.

Nur der vordere Teil des Tieres ist vorhanden. Figur 1 der Tafel II bildet es bei 10 facher Vergrösserung, von lateral gesehen, ab. In Figur 2 der Tafel II ist das terminale Ende bei 10 facher

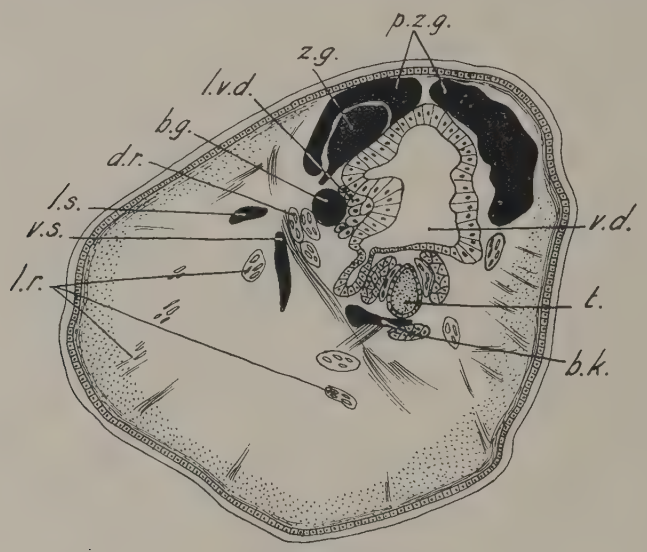

Fig. 22. 50 ×

Vergrösserung von Vorne gesehen abgebildet. Das Fragment ist 15 mm lang. Der vordere Teil ist blasenförmig erweitert; der Querdurchmesser dieses Teiles beträgt 2 mm. Der nächstfolgende Teil hat einen Querdurchmesser von 1 mm. Die Umgebung der Mundöffnung ist einigermassen vorgestreckt und trägt den rundlichen Mundschild, der die Mundöffnung umschliesst. Die Farbe ist gelbig (in Alkohol).

Das Tier war schon entkalkt, sodass Spicula fehlen. Auch das Integument ist nicht gut erhalten, jedoch sind Riesenzellen noch nachzuweisen.

Von den Ring- (Fig. 26, *r.m.*) und Diagonalmuskeln ist nichts Besonders zu erwähnen. Die 4 Längsmuskelfelder (Fig. 26, *l.m.*) sind kräftig ausgebildet; die beiden ventralen Felder verschwinden alsbald und treten etwas kranial wieder auf. An dieser Stelle teilen sich die beiden dorsalen Felder jedes in 3 Bündel (Fig. 25, *l.m.*), welche sich in zahlreiche Bündelchen aufspalten, was ebenso mit den ventralen Feldern der Fall ist. Der Hautmuskelschlauch des Vorderendes zeigt also ein ähnliches Verhalten wie bei *Cr. nitidulum* und *Cr. canadense.*

Die dorsalen (Fig. 22 und 23, *d.r.*) und lateralen Retraktoren (Fig. 22 und 23, *l.r.*) sind aus einigen kleinen Muskeln, welche sich eng aneinander schliessen, zusammengesetzt. Sie liegen auch

hier in dorso-lateralen und ventro-lateralen Falten des Mitteldarmes und ziehen ventro-kraniad. Die Insertion findet an der lateralen und ventro-lateralen Körperwand statt. Ein Paar ventraler Retraktoren

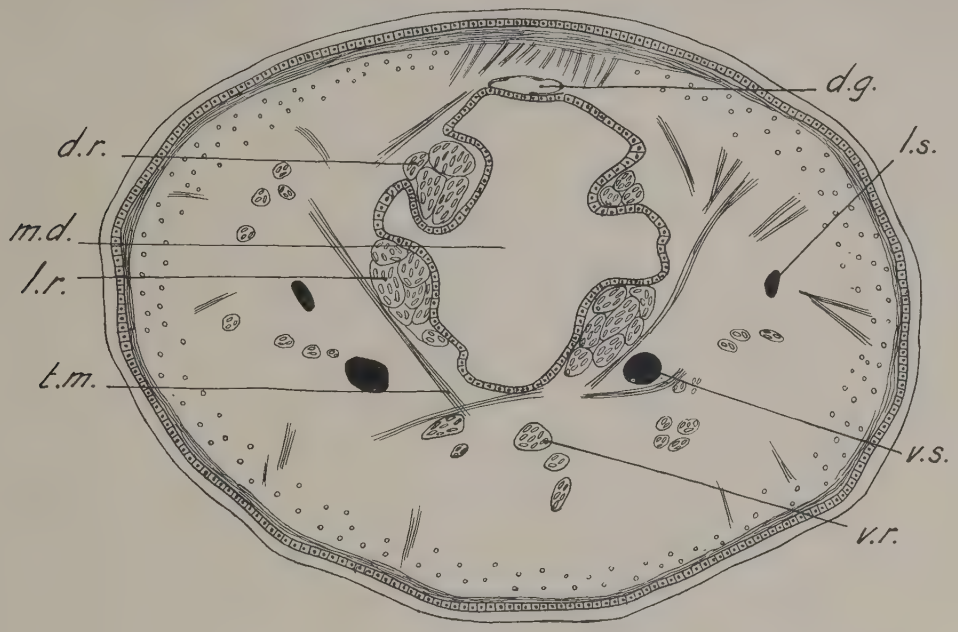

Fig. 23. 50 ×

(Fig. 23, *v.r.*) ist vorhanden und inseriert an der ventralen Körperwand. Das letztere Paar ist nicht leicht auf zu finden, da an dieser Stelle auch die Längsmuskelbündel die primäre Leibeshöhle durch-

Fig. 24. 333 ×

queren und auch teilweise zur ventralen Körperwand ziehen. Das horizontale Diaphragma (Fig. 25, *h.d.*), sowie das vordere vertikale Diaphragma sind vorhanden.

Das Nervensystem schliesst sich dem der vorher beschriebenen Arten eng an.

Fig. 25. 50 ×

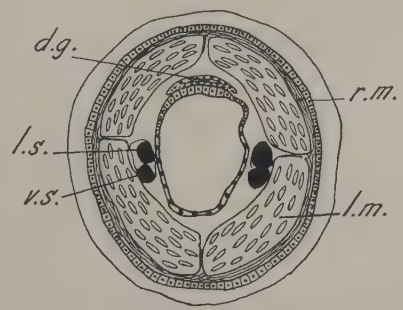

Fig. 26. 50 ×

Die kraniale Wand der Mundöffnung wird von Ganglienzellen, welche in ihrer Nähe liegen und mit den Praezerebralganglien zusammenhangen, innerviert, sodass ein Atrium ausgebildet ist.

Der Vorderdarm (Fig. 22, *v.d.*) bildet auch hier wieder zwei grosse Falten, in welchen die lateralen Vorderdarmdrüsen (Fig. 22, *l.v.d.*) münden. Auch ein kaudad ziehendes dorsales Vorderdarmcoecum mit den in ihn mündenden dorsalen Vorderdarmdrüsen sind vorhanden. Um die Mundöffnung herum liegen bukkale Drüsenzellen.

Der Träger (Fig. 22, *t.*) des Radulaapparates ist kutikular. Der freie kaudale Teil des Radulaapparates trägt auf seinem am meisten kaudalen Ende die Radula. Dieser besteht aus zwei Zähnchen, welche aber in vier Schnitten vorhanden sind. Die ersten drei Schnitte (Fig. 24 *a, b, c*) sind ungefähr quer getroffen; der vierte zeigt das distale Ende der Zähne in die Länge getroffen (Fig. 24 *d*).

Der Mitteldarm (Fig. 23, *m.d.*) ist im blasenförmig erweiterten Teil sehr geräumig und, wie schon erwähnt, an seinen dorso-lateralen und ventro-lateralen Seiten eingebuchtet. Im engeren Körperteil ist auch der Mitteldarm viel enger und seine Wand ist hier stark gefaltet.

5. *Crystallophrisson marioni* nov. spec.

Stat. 212. 1 Exemplar.

Diagnose: Vorderende blasenförmig erweitert; der herzförmige Mundschild enthält die Mundöffnung; die 4 Muskelfelder teilen sich zugleich in zahlreiche Bündelchen auf; einige dorsale und einige laterale Retraktoren vorhanden; ventrale Retraktoren fehlen; bukkale Drüsen, dorsale sowie laterale Vorderdarmdrüsen vorhanden; Radula von 2 Zähnchen gebildet; Mitteldarm dorso-lateral schwach eingebuchtet.

Auch von diesem Tiere ist nur das Vorderende vorhanden. Auf Tafel II ist es in Figur 3 10 fach vergrössert dargestellt. Der vordere Teil ist blasenförmig erweitert und, wie bei den beiden

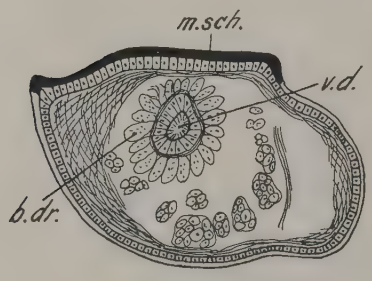

Fig. 27. 50 ×

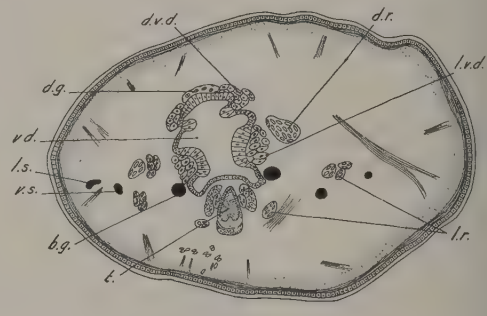

Fig. 28. 25 ×

vorigen Tieren, scharf gegen den nächstfolgenden Teil abgesetzt. In der Nähe des vordern vertikalen Diaphragmas ist der Körper deutlich eingeschnürrt. Das Fragment ist 10 mm lang. Der erweiterte Teil hat einen Querdurchmesser von 4 mm, der nächstfolgende Teil von 1½ mm und der dritte Teil von 1 mm. In Alkohol ist die Farbe gelb-grau. Die Mundöffnung liegt im herzförmigen Mundschild.

Das Tier war entkalkt, sodass die Spicula fehlen. Riesenzellen sind im Integument zu beobachten.

Die 4 Muskelfelder sind kräftig ausgebildet und spalten sich zugleich in zahlreiche Bündelchen (Fig. 31, *l.m.*) auf, wie es auch bei den drei zuerst beschriebenen Arten der Fall ist. An dieser

Stelle ist das vordere vertikale Diaphragma (Fig. 31, *v.v.d.*) vorhanden. Im blasenförmig erweiterten Teil ziehen die Längsmuskelbündel durch die geräumige primäre Körperhöhle und inserieren an der Körperwand. Von den übrigen Muskeln des Hautmuskelschlauches ist nichts besonderes zu erwähnen.

Wie beim vorigen Tiere legen sich die dorsalen, alsauch die lateralen Retraktoren eng aneinander in Einbuchtungen des Mitteldarmes (Fig. 30, *d.r.* und *l.r.*). Die Muskeln sind aber besser von-

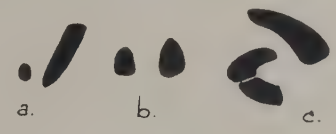

Fig. 29. 333 ×

einander getrennt als beim soeben beschriebenen Tiere und die dorso-lateralen und ventro-lateralen Einbuchtungen des Mitteldarmes sind weniger ausgebildet. Ventrale Retraktoren fehlen.

Vom Nervensystem ist nichts zu erwähnen.

Die am meisten terminalen Schnitte sind beschädigt, sodass nicht zu entscheiden ist, ob die kraniale Wand der Mundöffnung auch hier innerviert wird.

Der kraniale Teil des Vorderdarmes (Fig. 27, *v.d.*) besteht aus kubischen und zylindrischen Flimmerzellen und zahlreiche Bukkaldrüsen (Fig. 27, *b.dr.*) stehen um den Vorderdarm herum und münden in ihn ein. Auch ein Ringmuskelschicht umgibt den Vorderdarm. Kaudal von den Bukkaldrüsen ist das Vorderdarmepithel höher, deutlich drüsig und die Ringmuskelschicht dünner. Auch beim vorliegenden Tiere erweitert sich der Vorderdarm beim Radulaapparat beträchtlich (Fig. 28,

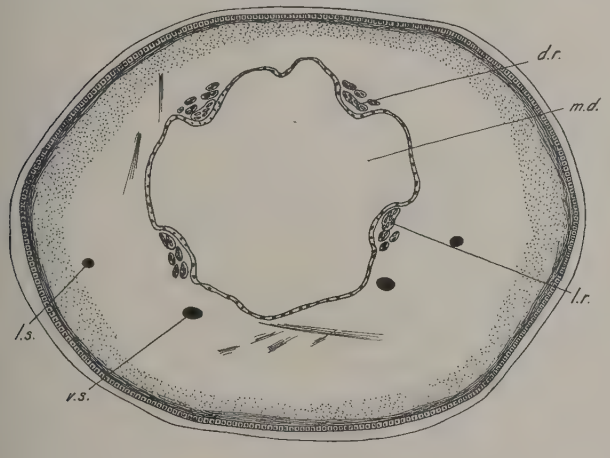

Fig. 30. 25 ×

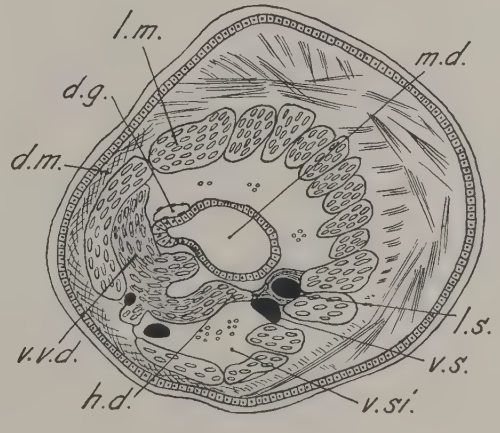

Fig. 31. 50 ×

v.d.) und bildet ein kaudal ziehendes Coecum an seiner dorsalen Seite. In dieses Coecum münden die dorsalen Vorderdarmdrüsen (Fig. 28, *d.v.d.*); in den lateralen Falten liegen die lateralen Vorderdarmdrüsen (Fig. 28, *l.v.d.*).

Der Radulaapparat ist aus den normalen Komponenten zusammengesetzt; er hat einen kutikularen Träger (Fig. 28, *t.*). Die Radula besteht aus zwei Zähnchen, welche in drei Schnitten vorhanden sind (Fig. 29). Der linke Zahnteil in *c* ist gebrochen, der rechte in *c* gibt den distalen Teil des rechten Zahnes wieder.

Im blasenförmig erweiterten Teil ist der Mitteldarm sehr geräumig; die Einbuchtungen sind

viel geringer als beim vorher beschriebenen Tiere (Fig. 30, *m.d.*). Sein Epithel ist flach bis kubisch mit runden Kernen. Im engeren Körperteil ist der Mitteldarm auch eng und bildet an dieser Stelle ein kaudal ziehendes ventrales Coecum. Der enge Mitteldarm ist aus kubischen bis zylindrischen und besonders keulenförmigen Zellen zusammengesetzt. Diese Zellen haben alle einen körnigen Inhalt.

Dondersia Hubrecht

6. *Dondersia indica* nov. spec.

Stat. 47; in 55 m Tiefe; 1 Exemplar.

Diagnose: Mässig lang; Körper an zwei Stellen transversal eingeschnürrt und kaudaler Teil angeschwollen; ohne Rückenkiel; Farbe gelb-grau (in Alkohol): Länge 20 mm: Längenindex 20; die Bauchfurche bleibt vom Analraum getrennt; zwei dorso-terminale Sinnesorgane; eine ventrale Drüse vorhanden; Analraum ohne kranialen Blindsack; die Ausführungsgänge der ventralen Speicheldrüsen münden gemeinsam; Radulatasche ⊃ förmig gebogen; ein Paar Samenblasen.

In Figur 4 der Tafel II ist das Tier 10 fach vergrössert abgebildet. Es ist wurmförmig. Die Länge beträgt 20 mm, der Querdurchmesser 1 mm, sodass der Längenindex 20 ist. In Alkohol ist die

Fig. 32. 250 ×

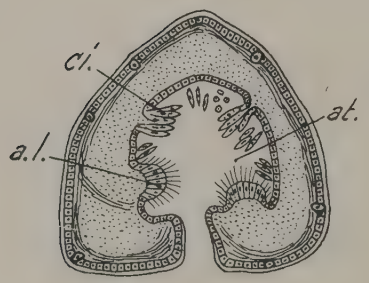

Fig. 33. 100 ×

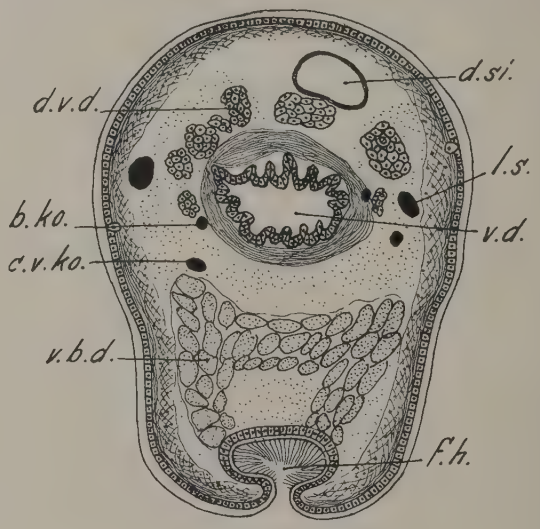

Fig. 34. 100 ×

Farbe gelb-grau. An zwei Stellen ist der Körper transversal eingeschnürrt, während der kaudale Teil etwas angeschwollen ist. Ein Ringelung, wie sie Nierstrasz (3, S. 33) für *Dondersia annulata* beschreibt, fehlt hier. Die Atrialöffnung liegt kranio-ventral, die Analraumöffnung kaudo-ventral. Gleich kaudal vom Atrium liegt die Mundöffnung, sodass der Vorderdarm getrennt vom Atrium nach aussen mündet. Flimmerhöhle und Bauchfurche sind deutlich. Letztere bleibt vom Analraum getrennt und enthält eine Bauchfalte.

Die Kutikula ist dünn. Die einschichtige Epidermis besteht aus schmalen, zylindrischen Zellen und aus zahlreichen, meistens becherförmigen Drüsenzellen, welche mit ihrem basalen Teil einigermassen im unterliegenden Bindegewebe eingesunken sind. Epidermispapillen fehlen.

Von Spicula habe ich nur die in Figur 32 abgebildete Form auffinden können, welche jedoch in verschiedener Grösse vorliegt.

Die Flimmerhöhle (Fig. 34, *f.h.*), welche aus schmalen zylindrischen Wimperzellen besteht, setzt sich in die Bauchfurche fort. Diese (Fig. 35, *b.f.*) hört in beträchtlicher Distanz vor dem Analraum auf. Sie enthält die schon erwähnte Bauchfalte (Fig. 35, *b.fa.*), welche von einer dünnen Kutikula und kurzen Zilien ausgekleidet wird.

Die vorderen Bauchdrüsen (Fig. 34, *v.b.d.*) fangen gleich kaudal vom Atrium an. Sie liegen um die Mundöffnung herum und öffnen in die Flimmerhöhle. Auch die hinteren Bauchdrüsen (Fig. 35, *h.b.d.*) sind vorhanden und zeigen keine Besonderkeiten.

Das geräumige Atrium (Fig. 33, *at.*) enthält die zahlreichen Cirren, welche in Gruppen vereinigt sind. Die Cirren (Fig. 33, *ci.*) sind schmal und unverzweigt. Die Atrialleisten sind kräftig ausgebildet (Fig. 33, *a.l.*).

Ich habe zwei dorso-terminale Sinnesorgane auffinden können. Das eine liegt dorsal vom Analraum, das zweite dorsal vom Perikard (Fig. 41, *d.t.s.*). Beide Organe sind vorgestülpt.

Das Epithel des Analraumes (Fig. 39, *a.r.*) ist ein gefaltetes Flimmerepithel. Ein Y-förmiger Divertikel des Analraumes ist hier nicht vorhanden.

Wohl aber ist, zwischen Analraum und das kaudale Ende der Bauchfurche, das Epithel der

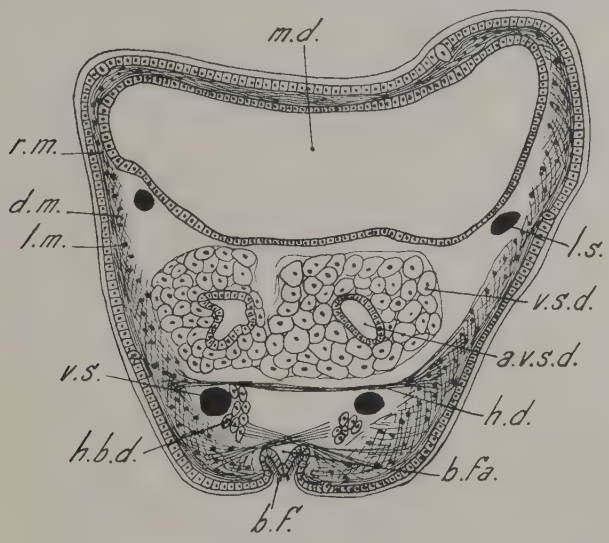

Fig. 35. 100 ×

ventralen Seite blindsackartig eingestülpt (Fig. 38, *v.du.*). Das Epithel dieses Blindsackes ist ein hohes prismatisches Drüsenepithel mit gedehnten Kernen und dünner Kutikula. Besonders bei der Mündung der Drüse ist das Epithel deutlich drüsig. Die ventrale Wand des Tieres ist, zwischen der Mündung der Drüse und der Analraumöffnung breitgrubenförmig eingebuchtet, sodass das Sekret der Drüse dieser Furche entlang den Analraum zufliessen kann. Die Bedeutung dieser ventralen Drüse ist noch unklar. Wahrscheinlich hängt sie mit dem Geschlechtsleben zusammen. Wenn eine Kopulation stattfinden dürfte, so ist es nicht ausgeschlossen, dass das Sekret das Aneinanderlegen der Tiere unterstützen würde. Solange aber keine eingehendere Beobachtungen vorliegen ist nichts Bestimmtes zu sagen.

Die Diagonalmuskeln (Fig. 35, *d.m.*) der Hautmuskelschlauch sind kräftig ausgebildet, die Ringmuskeln (Fig. 35, *r.m.*) bilden eine schwache Schicht, während die Längsmuskeln (Fig. 35, *l.m.*) zwischen den Diagonalmuskeln verlaufen. Beide Arten von Transversalmuskeln, sowie das horizontale Diaphragma (Fig. 35, *h.d.*) sind vorhanden.

Das Zerebralganglion liegt am kranialen Ende des Vorderdarmes, wo dieser nach aussen mündet. Atriale Ganglien fehlen. Kranio-lateral vom Zerebralganglion liegen die Lateralganglien und hängen mit ihm mittels kurzer Konnektive zusammen. Etwas kaudal von diesen Zerebro-lateralkonnektiven gehen die Zerebro-ventralkonnektive (Fig. 34, *c. v. ko.*) vom Zerebralganglion ab. Sie enden in den grossen Ventralganglien, welche ventrolateral von der Mündung der ventralen Speicheldrüsen liegen. Die Bukkalganglien liegen den Ausführungsgängen der ventralen Speicheldrüsen lateral an; sie werden von einer Kommissur vereinigt. Die Ganglia posteriora superiora und inferiora sind vorhanden. Ebenso die ventrale Kommissur und die Konnektive, welche sie miteinander verbinden. Eine Supra-rektalkommissur habe ich aber nicht auffinden können; sie wird aber sicher vorhanden sein.

Der Vorderdarm (Fig. 34, *v.d.*) mündet, wie erwähnt, getrennt vom Atrium, sodass die Mundöffnung kaudal von der Atrialöffnung liegt. Das stark gefaltete Epithel des Vorderdarmes besteht hauptsächlich aus zylindrischen Zellen mit gedehnten Kernen. Eine starke Ringmuskelschicht umgibt den Vorderdarm an der Aussenseite, während er an der Innenseite von einer dünnen Kutikula ausgekleidet wird.

Um den Vorderdarm herum liegen zahlreiche Pakete einzelliger Drüsen (Fig. 34, *d.v.d.*), welche sich kaudal den ventralen Speicheldrüsen eng anschliessen. Diese (Fig. 35, *v.s.d.*) liegen ventrolateral vom Vorderdarm und bestehen ebenso aus Paketen einzelliger Drüsen, welche die breiten Ausführungsgänge (Fig. 35, *a.v.s.d.*) diffus umgeben. Beim kranialen Ende der Radula vereinigen sich beide Ausführungsgänge und bilden einen sehr kurzen unpaaren Ausführungsgang. Kranial und kaudal vom Radulaapparat hat der Vorderdarm den gleichen Bau, sodass eine Trennung in Pharynx und Oesophagus fehlt.

Die Radulatasche ist ⊃ förmig gebogen, sodass sie in den Schnitten *a, b,* und *c* der Figur 36 zweimal getroffen worden ist. Die Wand des proximalen (oder dorsalen) Teiles besteht an der dorsalen Seite aus Zellen mit runden Kernen, während die Zellen der ventralen Wand gedehnte Kernen besitzen, wie NIERSTRASZ (5, S. 678) es auch für *Dondersia annulata* beschrieben hat. Durch die kraniale Umbiegung der Radulatasche ist die „dorsale" Wand des distalen Teiles der Tasche dagegen aus Zellen mit gedehnten Kernen und ihre „ventrale" Wand aus Zellen mit runden Kernen zusammengesetzt (Fig. 36 *a, b*). Wie die Schnitte *b* und *c* der Figur 36 zeigen ist an der ventralen Wand der Tasche eine Kutikula vorhanden.

Die Radula ist sehr klein und einige Zähne sind wahrscheinlich beim Schneiden gesplittert, sodass ihre Deutung nicht immer klar ist. Im ersten Schnitt (Fig. 36 *a*) ist der distale Teil der Tasche schräg getroffen. Man sieht zwei kleine Zähnchen, welche einander mit den Spitzen berühren oder verwachsen sind, was nicht zu entscheiden ist. Die Zähnchen sind „ventrad" gerichtet. Eine grosse, flache Platte liegt der „dorsalen" Wand an. Im zweiten Schnitt (*b*) liegen im distalen Teil der Tasche zwei schmale gebogene Zähnchen, welche sich nicht berühren. Im proximalen Teil der Tasche ist eine breite Platte vorhanden. Schnitt drei (*c*) zeigt das distale, etwas erweiterte Ende der Radulatasche und dorsal davon, im proximalen Teil, liegt eine Platte, die wahrscheinlich in 3 Stücke ge-

brochen ist. Der vierte Schnitt (*d*) gibt der proximale Teil der Radulatasche, unweit seiner Mündung in den Vorderdarm, wieder. Die längliche Platte ist wohl beim Schneiden in zwei Stücke geteilt worden. Im Vorderdarm liegt ein langer, spitzer Zahn, welcher aus zwei verwachsenen Zähnen besteht. Im nächstfolgenden Schnitt (*e*) liegt ein dergleicher Zahn im Vorderdarm und ventral von ihm liegt, noch in der Radulatasche (welche jetzt nicht mehr abgebildet ist) eine Platte, die dorsal schwache Zähnchen trägt. Deutlicher sind diese bei der Platte im nächstfolgenden Schnitt (*f*) ausgebildet. Auch diese Platte liegt in der Radulatasche. Die Schnitte *g* und *h* zeigen beide zugespitzte Zähne im Vorderdarm und eine Platte in der Radulatasche. In *g* sind die spitzen Zähne paarig und berühren

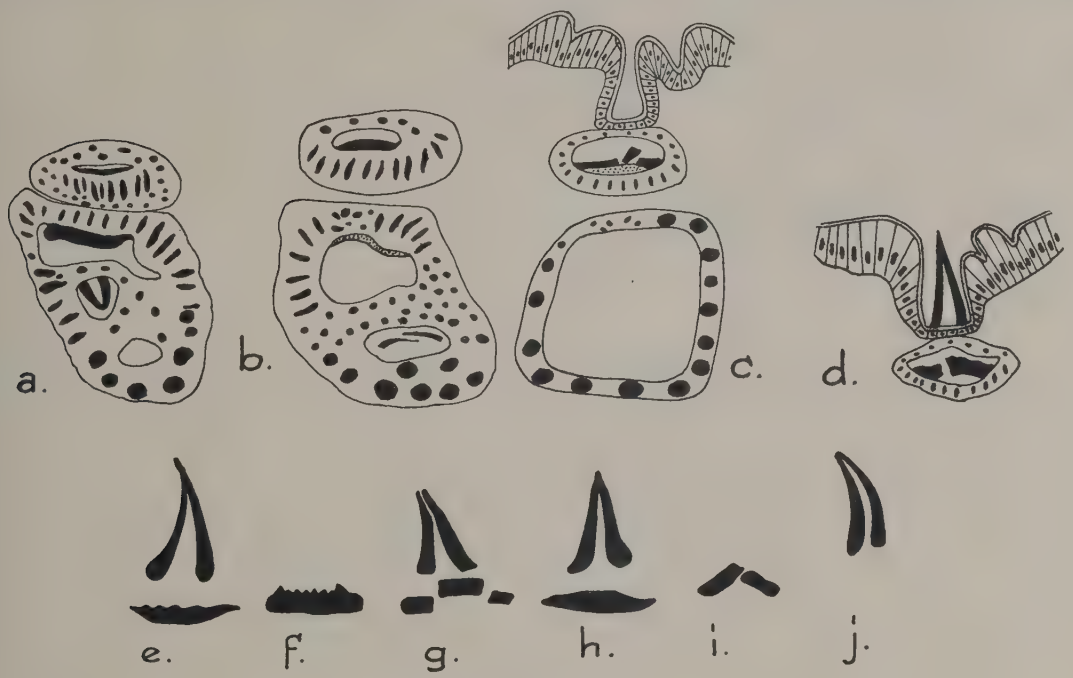

Fig. 36. 500 ×

einander nicht, in *h* sind sie mit den Spitzen verwachsen oder liegen aneinander. Die Platte in *g* ist in 3 Stücke gesplittert. Schnitt *i* gibt wahrscheinlich eine Platte wieder, die in 2 Stücken gebrochen ist und im Vorderdarm liegt, während der letzte Schnitt (*j*) wieder einen zusammengesetzten spitzen Zahn abbildet. Die Anzahl der Zähnchen beträgt wahrscheinlich 4 bis 5.

Aus dieser Beschreibung geht hervor, dass die Radula grosse Übereinstimmung mit der *Dondersia*-Radula zeigt. Wie bei *D. festiva* und D. *annulata* sind die länglichen Platten (*a* in NIERSTRASZ Figuren), mit und ohne Zähnchen vorhanden. Wahrscheinlich sind sie immer einheitlich und beim Schneiden gesplittert, was vielleicht auch bei *D. annulata* der Fall ist. Weiter sehen wir die mit den Spitzen verwachsenen Zähne (*d* bei *D. festiva* in NIERSTRASZ Figuren). Die birnförmigen Zähne von *D. festiva* sind hier, ebensowenig wie bei *D. annulata,* vertreten. Vielleicht, dass der untere Zahn im Schnitt *a* als einen solchen zu deuten wäre. Deutliche Übergänge in der Zahnform, wie sie für *D. festiva* charakteristisch sind, fehlen hier wie bei *D. annulata.* In Anzahl und Reihenfolge der Zähne bestehen auch Unterschiede mit *D. annulata.* HEATH (1, S. 157) beschreibt für *D. californica* weder Platten mit Zähnchen noch Übergänge in der Zahnform. Vielmehr dürfte nach HEATH bei

D. californica jeder Zahn aus Platte und zusammengesetzten Zahn bestehen. Meine Schnitte bringen keine Beweise für diese Ansicht, ebensowenig wie für NIERSTRASZ' Vermutung, dass die spitzen Zähne sich mittels birnförmiger aus den Platten entwickelt haben dürften, welche letztere sich in zwei Teile

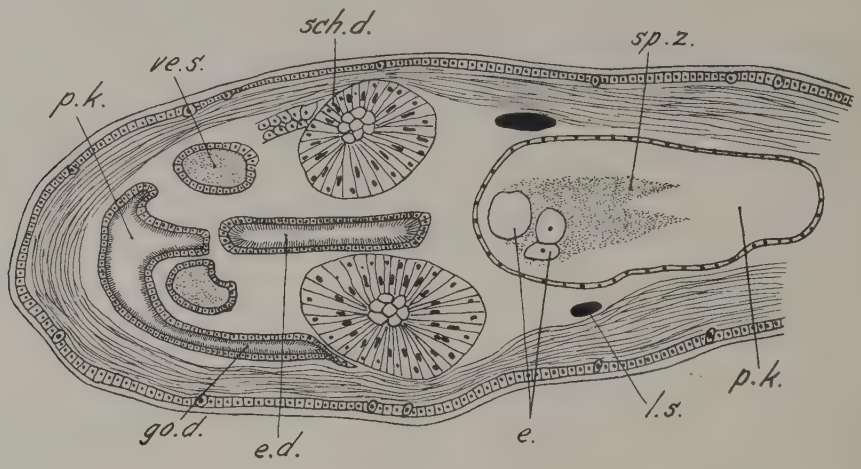

Fig. 37. 100 ×

gespalten haben sollten. Im distalen Teil der Radulatasche des vorliegenden Tieres sind die zugespitzten Zähne schon vorhanden und es hat den Anschein, dass diese sich unabhängig von den Platten

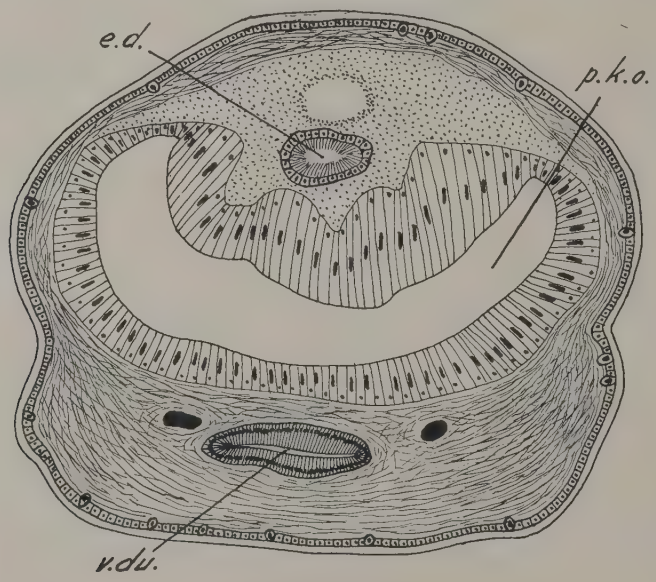

Fig. 38. 100 ×

ausbilden, ohne sich ihnen näher anzuschliessen. Auch weiter proximal bleiben sie von den Platten getrennt.

Ein Mitteldarmcoecum ist vorhanden; es bildet aber keine laterale Ausbuchtungen aus.

Auch der Mitteldarm (Fig. 35, *m.d.*), der zuerst geräumig ist, hat in seinem vordern Teil keine

Coeca; weiter kaudal verjüngt er sich und zahlreiche laterale Ausbuchtungen sind dann vorhanden. Die Struktur des Mitteldarmes ist nicht mehr zu studieren, weil die Konservierung mangelhaft ist.

In einer Arbeit, zusammen mit weiland Herrn Prof. NIERSTRASZ, beschrieb ich (6) bei einigen Solenogastren das Vorhandensein von Keulen- und Körnerzellen im Mitteldarm. Besonders bei *Rhopalomenia aglaopheniae* sind Keulenzellen mit ihren Einschlüssen in den lateralen Ausbuchtungen des Mitteldarmes deutlich zu beobachten. Daneben enthält der Mitteldarm auch zahlreiche Zellen mit körnigem Inhalt bei den Solenogastren. Letzteres ist aber eine sehr allgemeine Erscheinung und jede Zelle mit körnigem Inhalt braucht natürlich noch keine Körnerzelle zu sein. Die Feststellung der Homologie der von mir beschriebenen Zellen mit körnigem Inhalt bei einigen Solenogastren und der Körnerzellen der Mitteldarmdrüse der Crystallophrissontidae bedarf denn auch einer eingehenderen zytologischen Begründung. Das Vorkommen der Keulenzellen, besonders

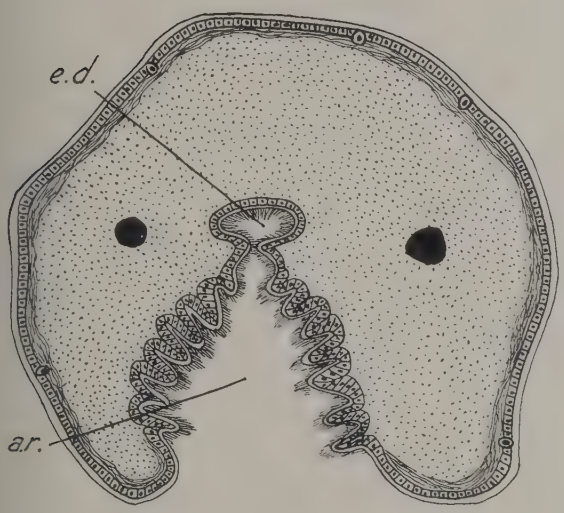

Fig. 39. 100 ×

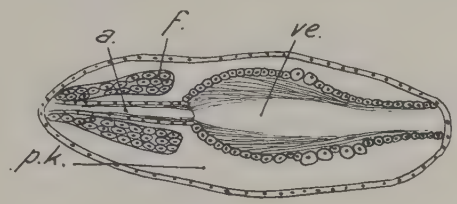

Fig. 40. 100 ×

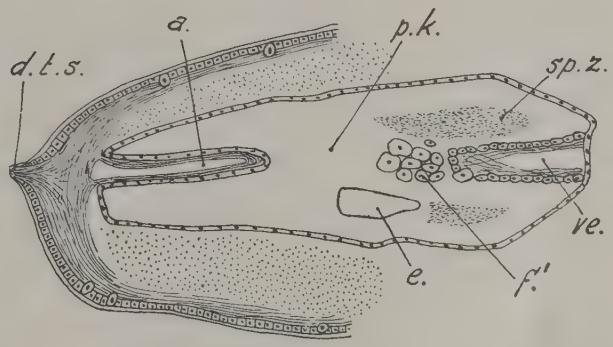

Fig. 41. 100 ×

bei *Rhopalomenia aglaopheniae,* ist m.E. auch bei den gröberen anatomischen Methoden, wohl als gesichert zu betrachten, während meine Behauptung, dass Körnerzellen ausser bei den Crystallophrissontidae auch bei den übrigen Solenogastren vorkommen sollen, mehr eine Suggestion darstellt als dass wohlbegründete Tatsachen vorliegen.

Der enge Enddarm (Fig. 38, *e.d.*) hat ein kubisches Wimperepithel und mündet, kaudal vom praekloakalen Organ, in den dorsalen Teil des Analraumes.

Das Tier ist geschlechtsreif. Die Gonaden haben normalen Bau. Perikard, Herz und der grössere Teil der Analraumgänge sind frontal geschnitten, weil das Tier stark gekrümmt war (Fig. 37).

Die Gonodukte (Fig. 37, *go.d.*) gehen vom kaudalen Ende des Perikards ab und ziehen kraniad. Sie besitzen ein Wimperepithel. Die Schalendrüsen (Fig. 37, *sch. d.*) und das grosse praekloakale Organ (Fig. 38, *p.k.o.*) zeigen keine Besonderheiten. Letzteres mündet in den am meisten kranialen Teil des Analraumes. In die Anfangsteile der Gonodukte öffnet jederseits ein Vesiculum seminalis (Fig. 37, *ve.s.*), wie auch NIERSTRASZ (3, S. 35) es für *D. annulata* fand, während *D. festiva*

zwei Paare von Samenblasen besitzt. *D. californica* ist eine Jugendform und hat daher wahrscheinlich noch keine Samenblasen ausgebildet. Die Vesiculae seminalis enthalten zahlreiche Spermatozoen. In Figur 37 sieht man, dass auch das Perikard (*p.k.*) Spermatozoen und daneben Eier (*e.*) enthält. Kopulationsstacheln fehlen.

Wie bei den andern *Dondersia*-Arten fehlen perikardiale Ausläufer. Das Atrium (Fig. 40, *a.*) ist auch hier eine Einstülpung der dorso-kaudalen Perikardwand und es liegt mit seinem kranialen Teil frei im Perikard. Wie bei *D. festiva* hat es zwei Flügel (Fig. 40, *f.*). Zwar legt sich das Atrium dem Ventrikel an, aber es kommuniziert nicht mit ihm. Der Ventrikel (Fig. 40, *ve.*) ist ebenso eine Einstülpung der dorsalen Perikardwand. Er hat nur einen Flügel, welcher hauptsächlich von seiner ventralen Wand gebildet wird (Fig. 41, *f'.*). Für *D. festiva* beschreibt NIERSTRASZ (4, S. 25) einen dergleichen Flügel.

Es ist klar, dass hier eine *Dondersia* Spezies vorliegt. Sie ist *Dondersia annulata* am Nächsten verwandt, worauf der Bau der Radula, das Vorhandensein von nur ein Paar Samenblasen, sowie das Fehlen eines kranialen Blindsackes am Analraum hinweisen. Auch stimmt sie in der geographischen Verbreitung mit *Dondersia annulata* überein. Jedoch zeigt die neue Art in äusserer Körperform, in der Trennung der Bauchfurche vom Analraum, im Besitz einer ventralen Drüse, in der typischen Gestalt der Radulatasche und im Bau der Radula ihre Selbständigkeit den anderen *Dondersia*-Arten gegenüber.

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BEDEUTUNG DER BUCHSTABEN AN DEN FIGUREN

a. = Atrium (Herz).
a.l. = Atrialleiste.
a.r. = Analraum.
at. = Atrium.
a.v.s.d. = Ausführungsgang der ventralen Speicheldrüsen.
b.dr. = Bukkaldrüsen.
b.f. = Bauchfurche.
b.fa. = Bauchfalte.
b.g. = Bukkalganglion.
b.k. = Bukkalkommissur.
b.ko. = Bukkalkonnektiv.
ci. = Cirre.
c.v.ko. = Zerebro-ventralkonnektiv.
d.g. = dorsales Gefäss.
d.m. = Diagonalmuskeln.
d.r. = dorsaler Retraktor.
d.si. = dorsaler Sinus.
d.t.s. = dorso-terminales Sinnesorgan.
d.v.d. = dorsale Vorderdarmdrüse.
e. = Ei.
e.d. = Enddarm.
f., *f'.* = Flügel des Herzens.
f.h. = Flimmerhöhle.
go.d. = Gonodukt.
g.p.s. = Ganglion posterius superius.
g.z. = Ganglionzelle.
h.b.d. = hintere Bauchdrüse.
h.d. = horizontales Diaphragma.
h.d.r. = hinterer dorsaler Retraktor.
h.v.r. = hinterer ventraler Retraktor.
k. = Kieme.
l.a.v. = linke atrio-ventrikulare Öffnung.
l.f. = Lateralfalte.
l.m. = Längsmuskeln.
l.r. = lateraler Retraktor.
l.s. = Lateralstrang.
l.v.d. = laterale Vorderdarmdrüse.
l.v.r. = latero-ventraler Retraktor.
m.d. = Mitteldarm.
m.sch. = Mundschild.
p.k. = Perikard.
p.k.a. = perikardialer Ausläufer.
p.k.o. = praekloakales Organ.
p.z.g. = Praezerebralganglien.
r.a.v. = rechte atrio-ventrikulare Öffnung.
r.m. = Ringmuskeln.
sch.d. = Schalendrüse.
sp.z. = Spermatozoon.
t. = Träger der Radula.
t.m. = Transversalmuskeln.
v.b.d. = vordere Bauchdrüse.
v.d. = Vorderdarm.
v.d.r. = vorderer dorsaler Retraktor.
v.du. = ventrale Drüse.
ve. = Ventrikel.
ve.s. = Vesicula seminalis.
v.g. = Ventralganglion.
v.r. = ventraler Retraktor.
v.s. = Ventralstrang.
v.s.d. = ventrale Speicheldrüse.
v.si. = ventraler Sinus.
v.v.d. = vorderes vertikales Diaphragma.
v.v.r = vorderer ventraler Retraktor.
z.g. = Zerebralganglion.
z.l.k. = Zerebro-lateralkonnektiv.
z.v.k. = Zerebro-ventralkonnektiv.

TAFEL I

Fig. 1. *Crystallophrisson sibogae* nov. spec. Rekonstruktion.
Fig. 2. *Crystallophrisson indicum* nov. spec. Von der lateralen Seite gesehen.
Fig. 3. *Crystallophrisson orientale* nov. spec. Von der lateralen Seite gesehen.
Fig. 4. *Crystallophrisson orientale* nov. spec. Vorderende von Vorne gesehen; 20 fach vergrössert.
Fig. 5. *Crystallophrisson orientale* nov. spec. Hinterende 20 fach vergrössert.

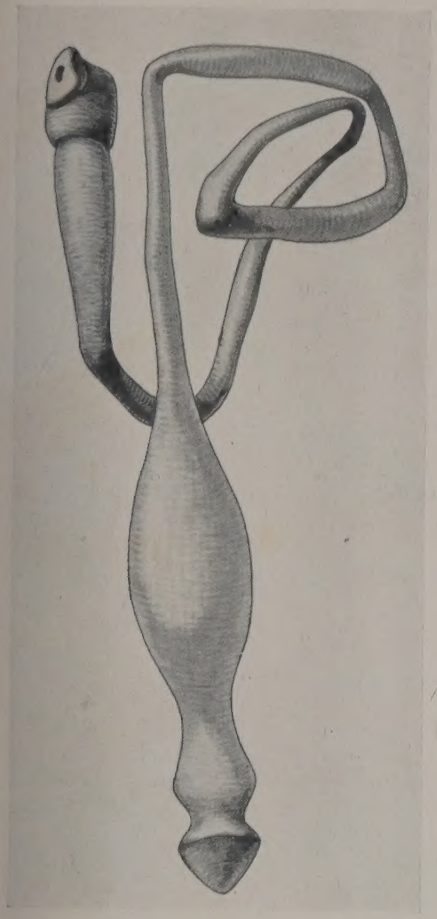

Fig. 1. 5 ×

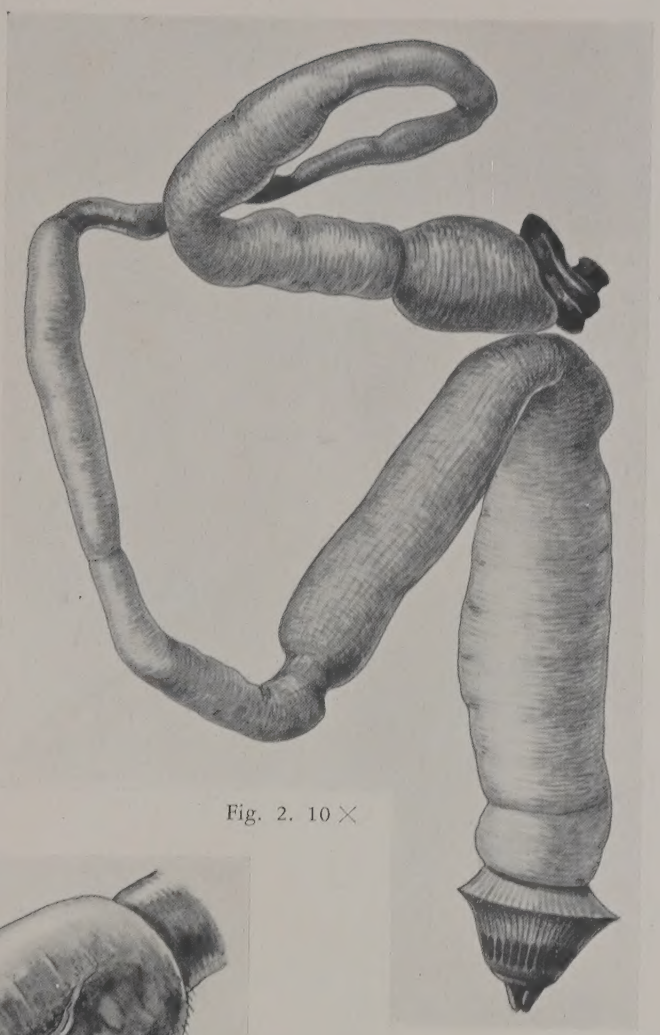

Fig. 2. 10 ×

Fig. 3. 8 ×

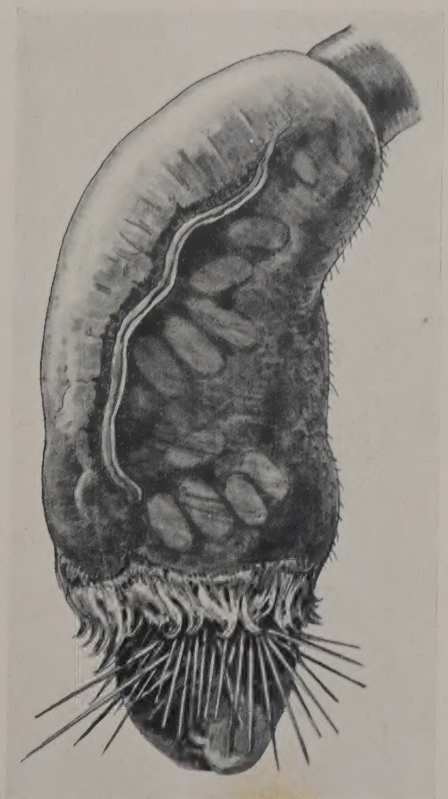

Fig. 5. 20 ×

Fig. 4. 20 ×

TAFEL II

Fig. 1. *Crystallophrisson odhneri* nov. spec. Vorderende von der lateralen Seite gesehen.
Fig. 2. *Crystallophrisson odhneri* nov. spec. Vorderende von Vorne gesehen.
Fig. 3. *Crystallophrisson marioni* nov. spec. Vorderende von Vorne gesehen.
Fig. 4. *Dondersia indica* nov. spec.; von der lateralen Seite gesehen.

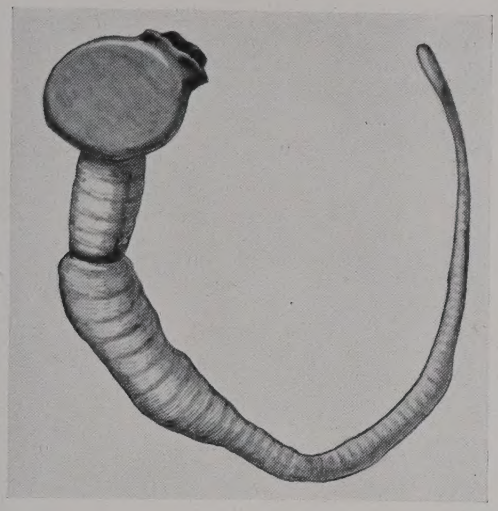

Fig. 1. 10×

Fig. 2. 10×

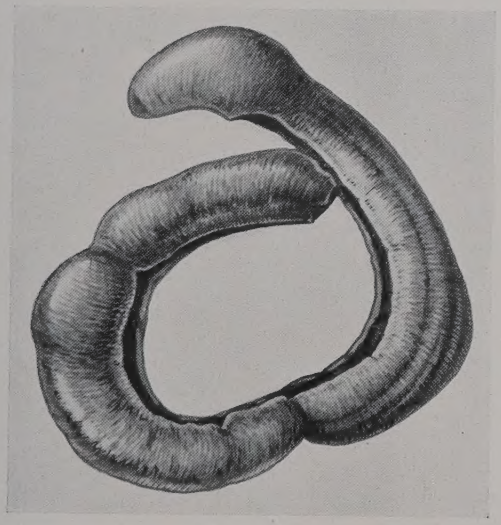

Fig. 4. 10×

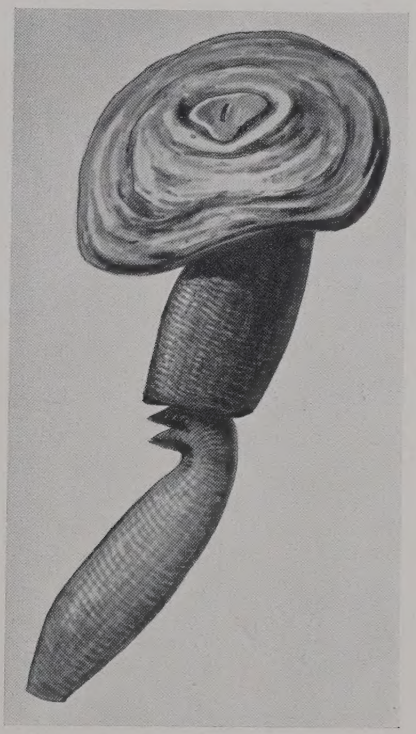

Fig. 3. 10×